

MED-AFEs Design Reference Manual

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This document explains how to test all Analog Front Ends using TWR-K53N512-KIT with the exception of the MED-STETH demo (digital stethoscope).

The MED-STETH uses TWR-LCD and requires different software and procedures to run the demo. If you want to test the MED-STETH demo, refer to the Medical Stethoscope Design Reference Manual DRM132, which can be found at freescale.com. Open the MED-STETH page as shown below and select User Manual on the Downloads section.

1 Hardware Set

1.1 Required Elements

The following elements are required to set up and assemble your Tower System for use with the demo.

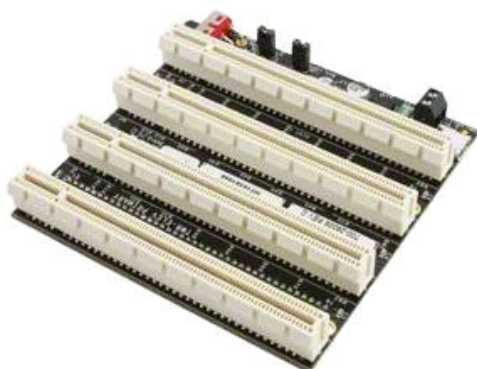
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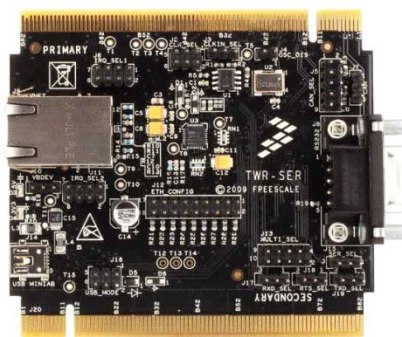




**TWR-ELEV
Secondary**



**TWR-ELEV
Primary**



TWR-SER



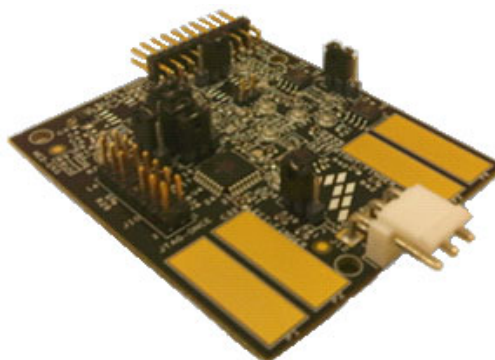
TWR-K53N512



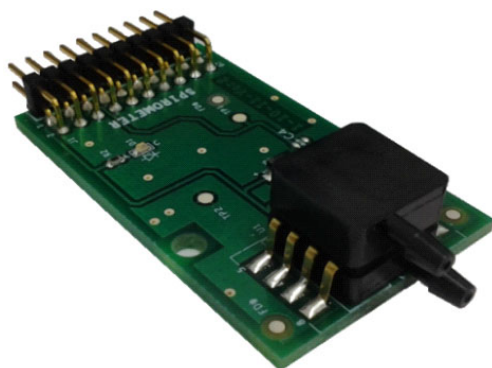
MED-BPM



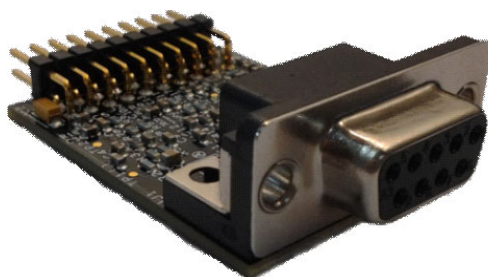
MED-GLU



MED-EKG



MED-SPI



MED-EKG



2 USB mini cables

1.2 Jumper Configuration

To use the boards, set the jumper configuration according to the following tables.

Open means a jumper should not be placed. Connected means only two pins exist and a jumper must be placed.

The following jumper configurations work with all the Analog Front Ends (AFEs).

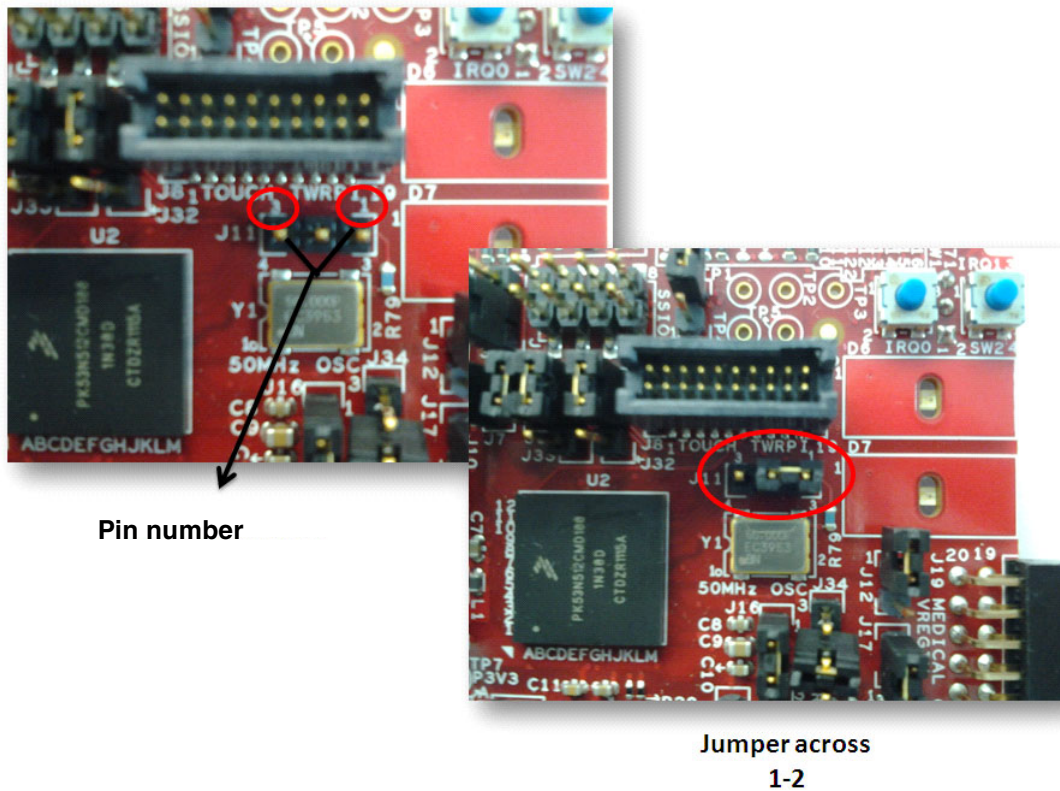


Figure 1. Jumper configurations

1.2.1 TWR-SER Jumper Configuration

Table 1. TWR-SER Jumper configuration

Jumper	Position
J10	1-2
J16	3-4
J2	1-2

1.2.2 TWR-K53N512 Jumper Configuration

Table 2. TWR-K53N512 Jumper configuration

Jumper	Position
J1	Open
J3	Open
J4	2–3
J11	1–2
J15	Connected
J17	Connected
J18	Connected
J24	1–2
J28	Open
J34	Open

1.2.3 MED-EKG Jumper Configuration

Table 3. MED-EKG Jumper configuration

Jumper	Position
J2	1–2
J3	1–2
J4	1–2
J6	2–3
J7	2–3
J11	2–3

1.3 Assembling the demo for MED-BPM, MED-GLU, MED-EKG, MED-SPI, and MED-SPO2

1. Take the controller module and TWR-ELEV primary board and connect the side of the controller module marked as "primary" to one of the slots on the TWR-ELEV primary board.

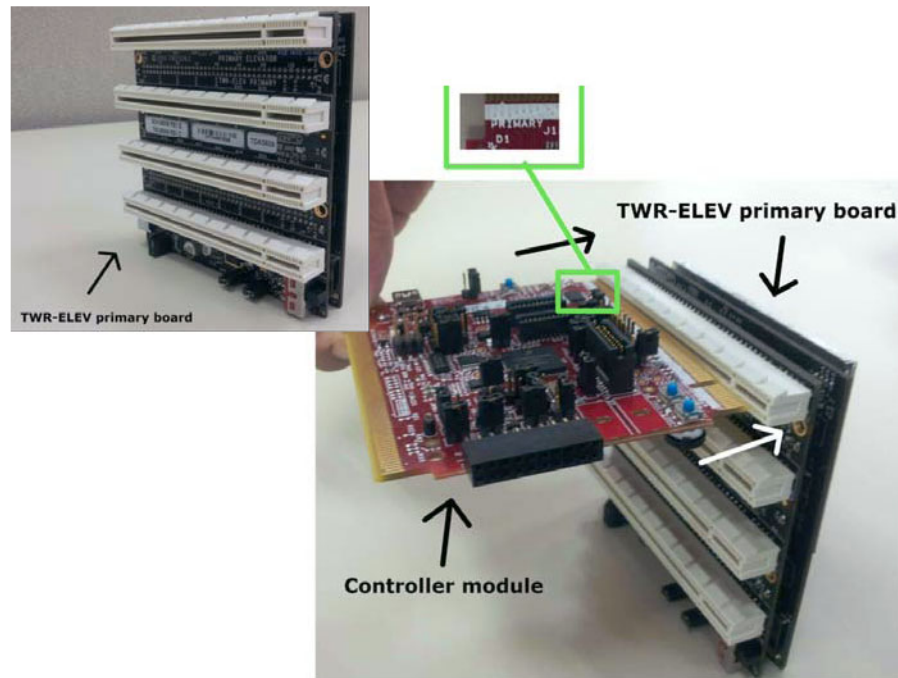


Figure 2. Assembling Demo (Step 1)

2. Take the TWR-SER board and connect the side of the TWR-SER board marked as "primary" to one of the slots on the TWR-ELEV primary board.

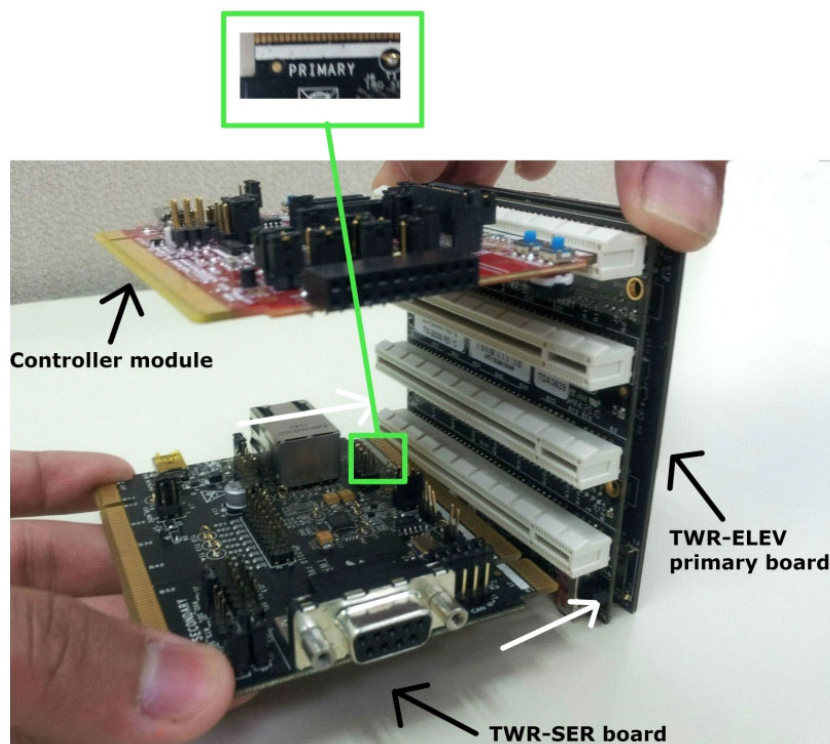


Figure 3. Assembling Demo (Step 2)

3. Take the TWR-ELEV secondary board and connect the side of the controller module and TWR-SER board marked as "secondary" to the respective slot on the TWR-ELEV secondary board.

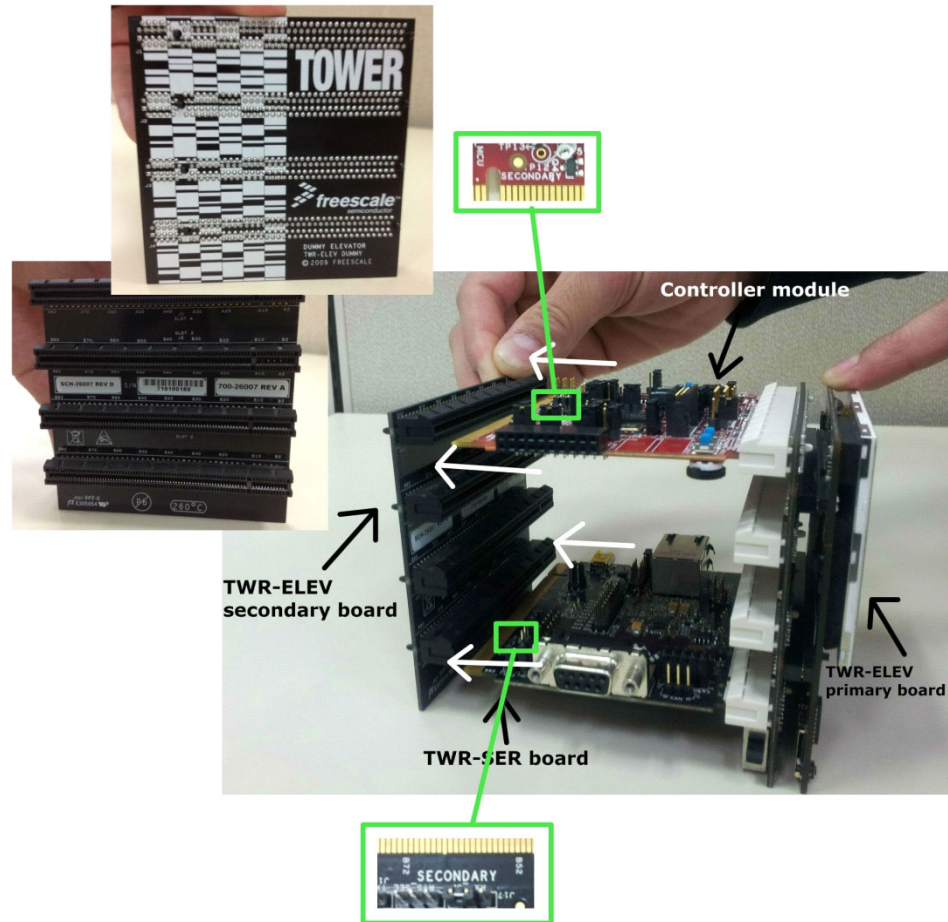


Figure 4. Assembling Demo (Step 3a)

After it is assembled, the Tower System will look like the following image.

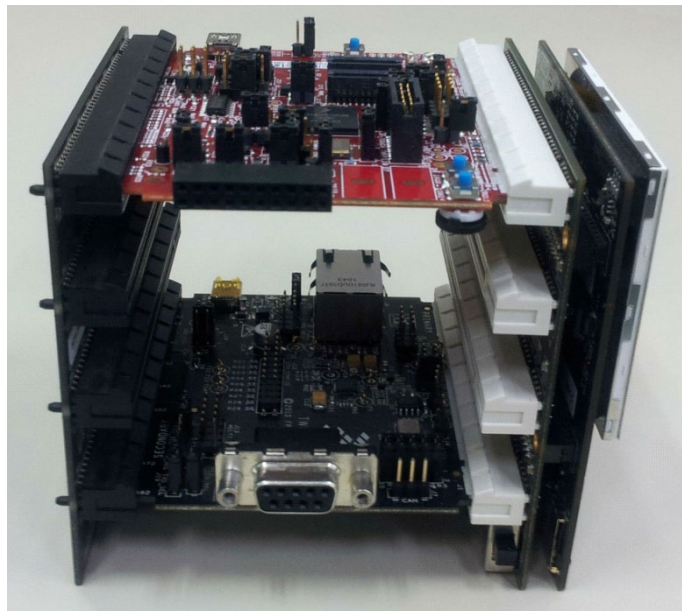


Figure 5. Assembling Demo (Step 3b)

4. Take the AFE board and connect it to the medical connector on the controller board. The medical connector pin's number should mirror the AFE pin number.

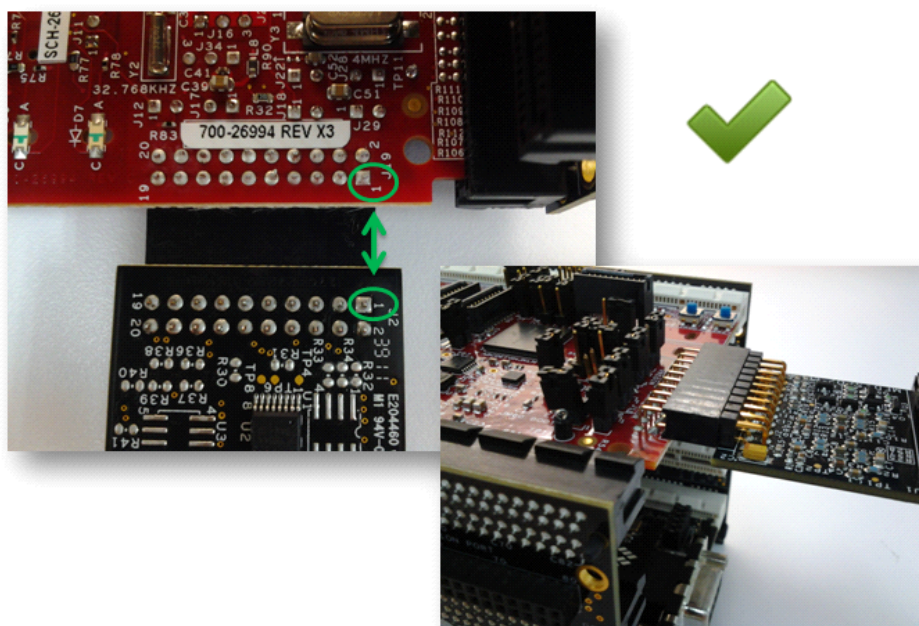


Figure 6. Assembling Demo (Step 4a)

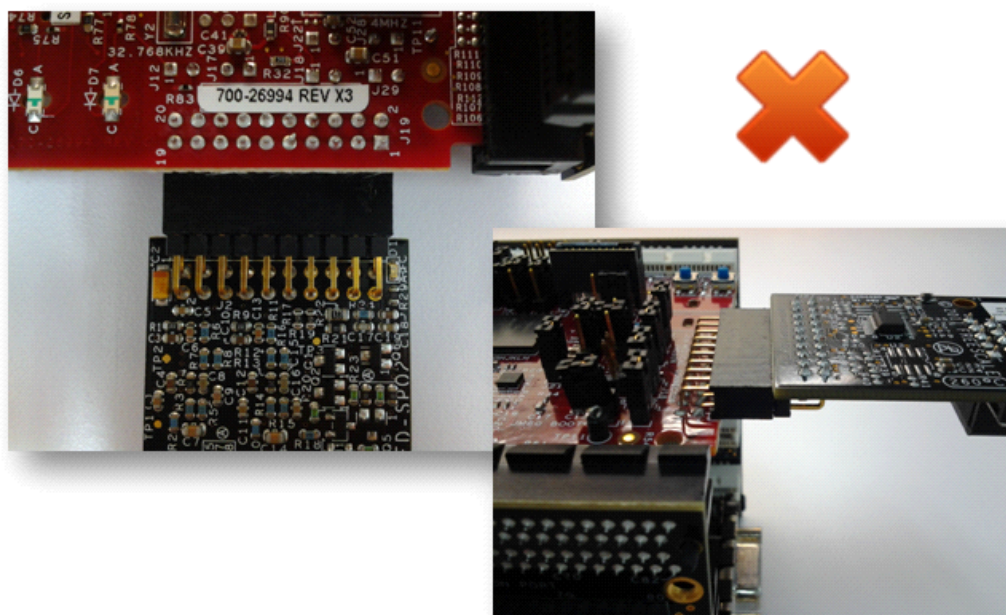


Figure 7. Assembling Demo (Step 4b)

2 Loading Software

The following steps will show how to load the microcontroller software. With this software, all the demos (with the exception of the MED-STETH demo) can be used without reprogramming the controller board. To program the MED-STETH demo, refer to the MED-STETH User Manual.

2.1 Installing IAR for Cortex M4 (TWR-MK53N512)

1. Visit the IAR webpage www.iar.com



Figure 8. Installing IAR (Step 1)

2. Search for IAR Embedded Workbench for ARM® and download version 6.2 or higher.

2.2 Installing the JM60 driver

2.2.1 Installing the JM60 driver for TWR-MK53N512

1. Visit <http://www.pemicro.com/osbdm/index.cfm> and download the OSBDM Virtual Serial Toolkit software.

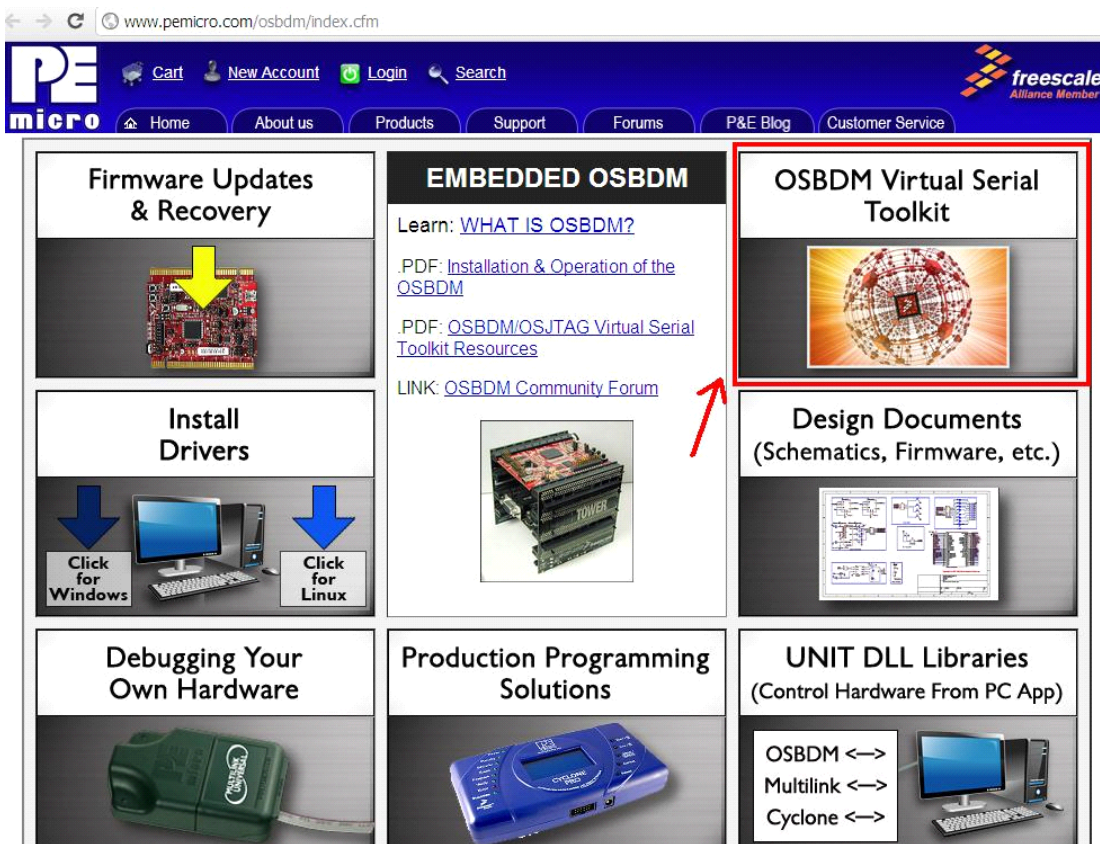


Figure 9. Installing JM60 Driver (Step 1)

2. Install P&E Micro Kinetis Tower Toolkit by clicking the executable, then follow the onscreen instructions to complete the installation.

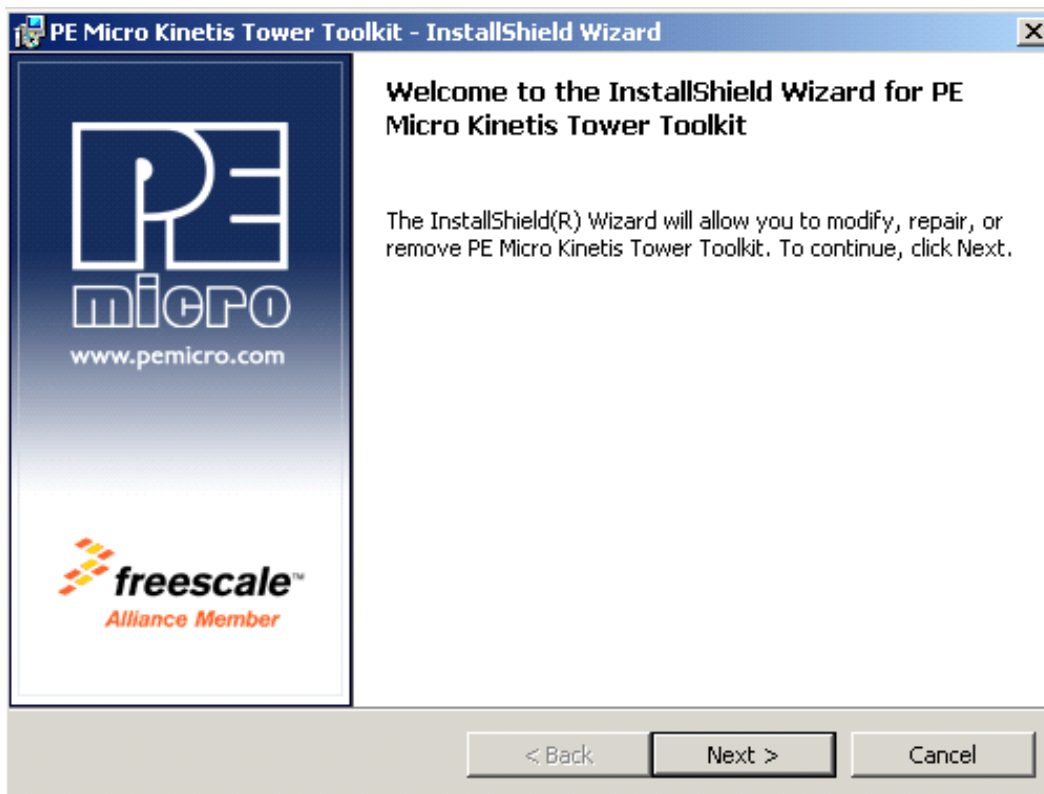


Figure 10. Installing JM60 Driver (Step 2)

3. Connect the TWR-MK53N512 module of the Tower system to the computer using a Mini USB-to-USB cable.

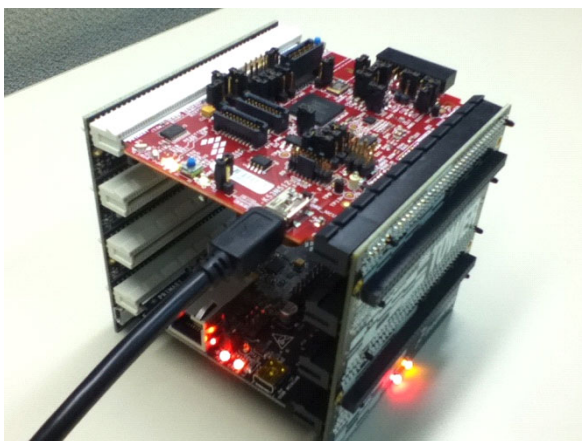


Figure 11. Installing JM60 Driver (Step 3)

4. Verify that the TWR is recognized by the computer as an "OSBDM - Debug Port":



Figure 12. Installing JM60 Driver (Step 4)

5. When the "Found New Hardware Wizard" screen appears, select "Install from a list or specific location (Advance)" and click "Next".

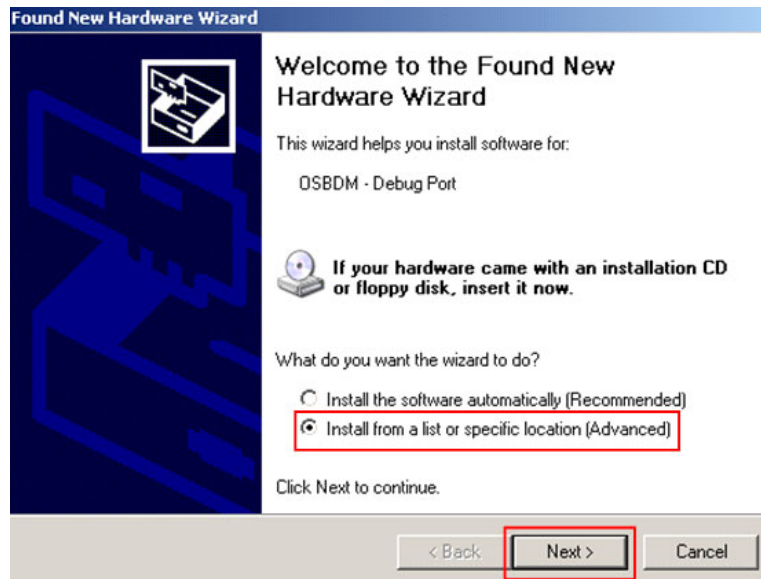


Figure 13. Installing JM60 Driver (Step 5)

6. In the next window, click "Browse" and select the following folder: C:\pemicro\kinetis_tower_toolkit\Drivers\osbdm. Then click "Next".

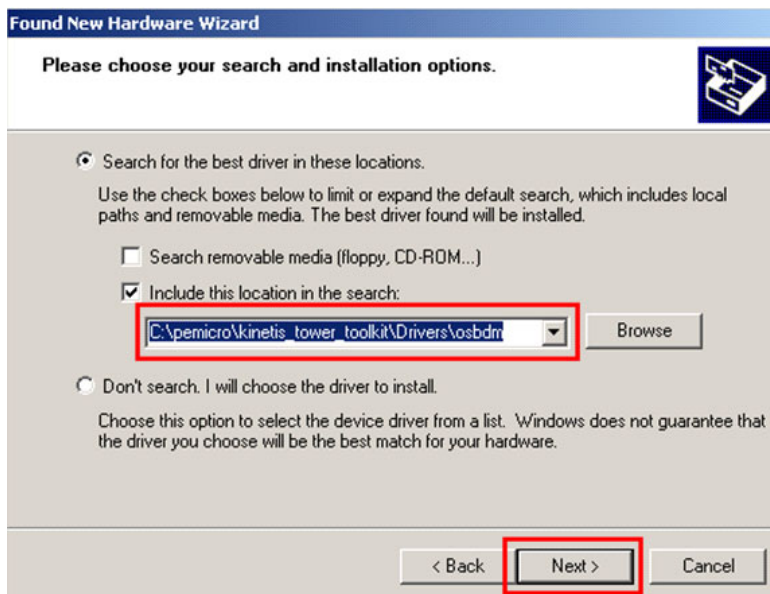


Figure 14. Installing JM60 Driver (Step 6)

7. Wait while the driver is being installed.

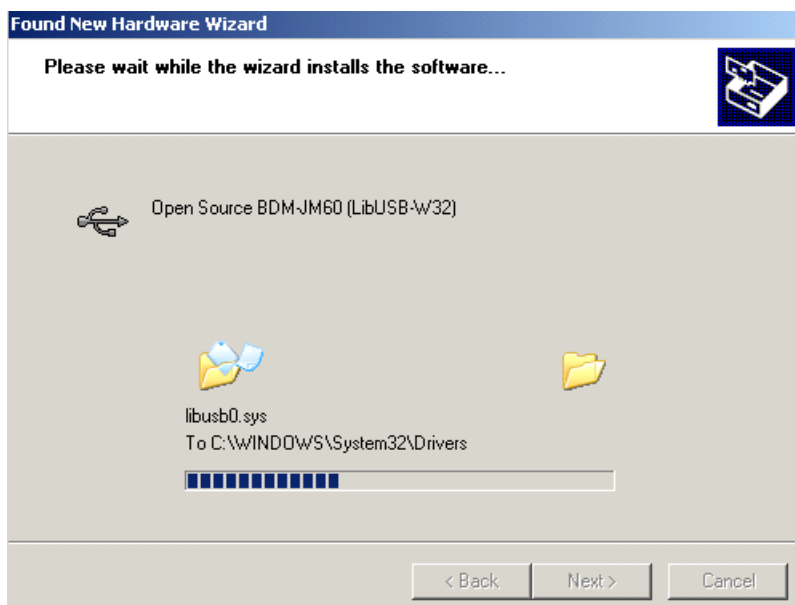


Figure 15. Installing JM60 Driver (Step 7)

8. After the "Open Source BDM-JM60" driver is installed, click "Finish".

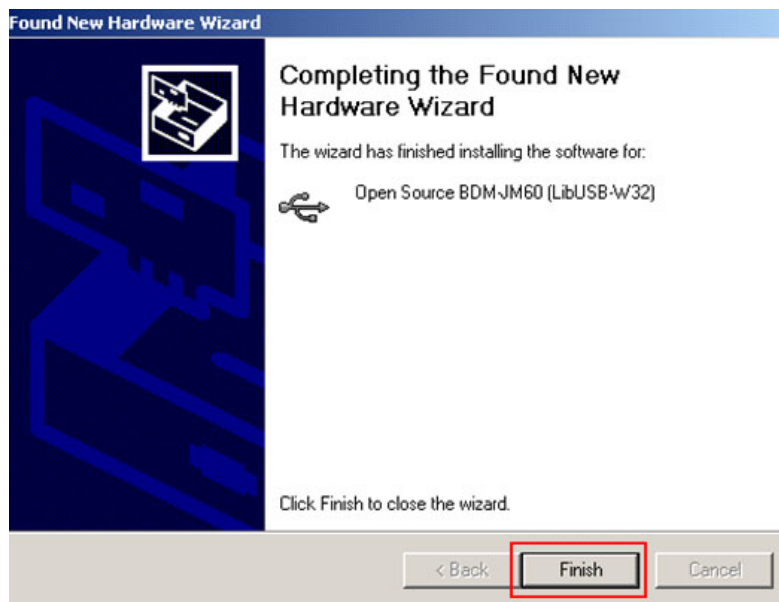


Figure 16. Installing JM60 Driver (Step 8)

9. The new hardware will be installed and ready to use.

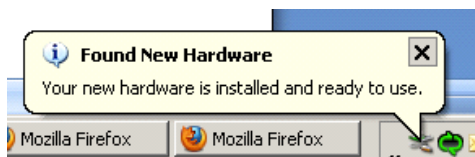


Figure 17. Installing JM60 Driver (Step 9)

2.3 Loading software for TWR-MK53N512 with IAR for Cortex M4

1. Open the IAR Embedded Workbench software.

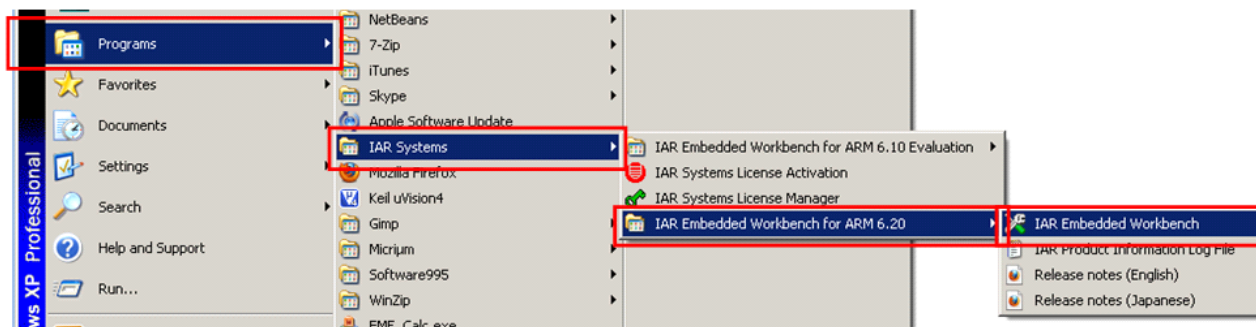


Figure 18. Loading Software (Step 1)

2. The program will look like the following:

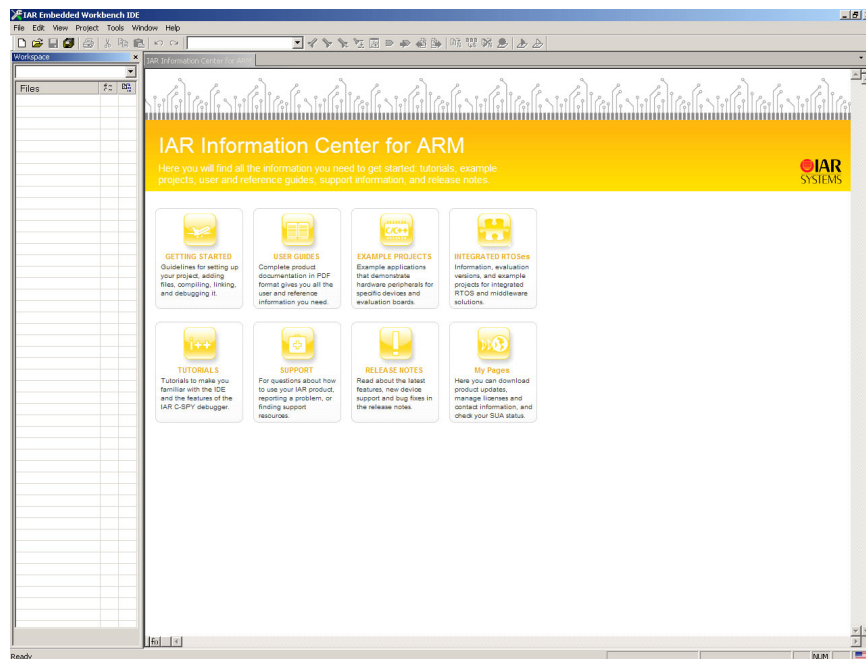


Figure 19. Loading Software (Step 2)

3. Go to "File", "Open" and then "Workspace..." to open the special software for the Healthcare AFE reference platform. Uncompress the file "SUITCASE_SW.zip" and open the file USB_CDC.eww on the route (Kiosk_USB_STACK_3.0_K53\app\cdc\iar_ew\kinetis\USB_CDC.eww).

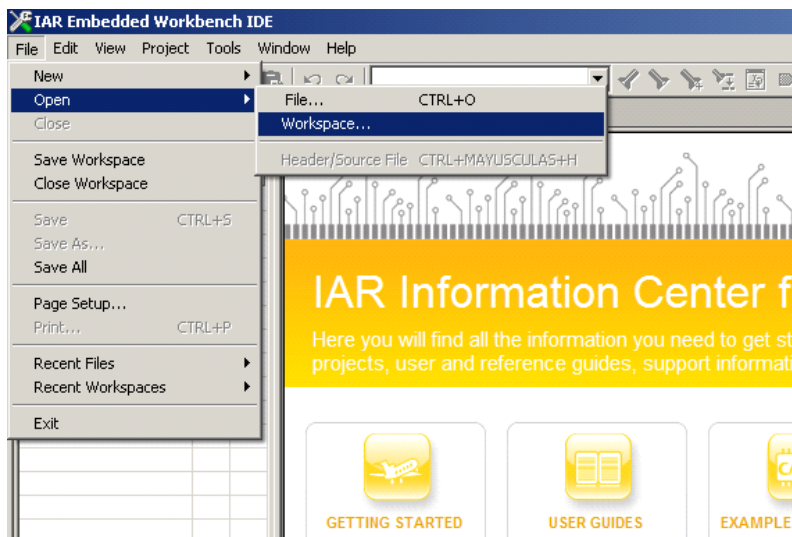


Figure 20. Loading Software (Step 3a)

Note: Special software for the Healthcare AFE reference platform can be found at the DVD.

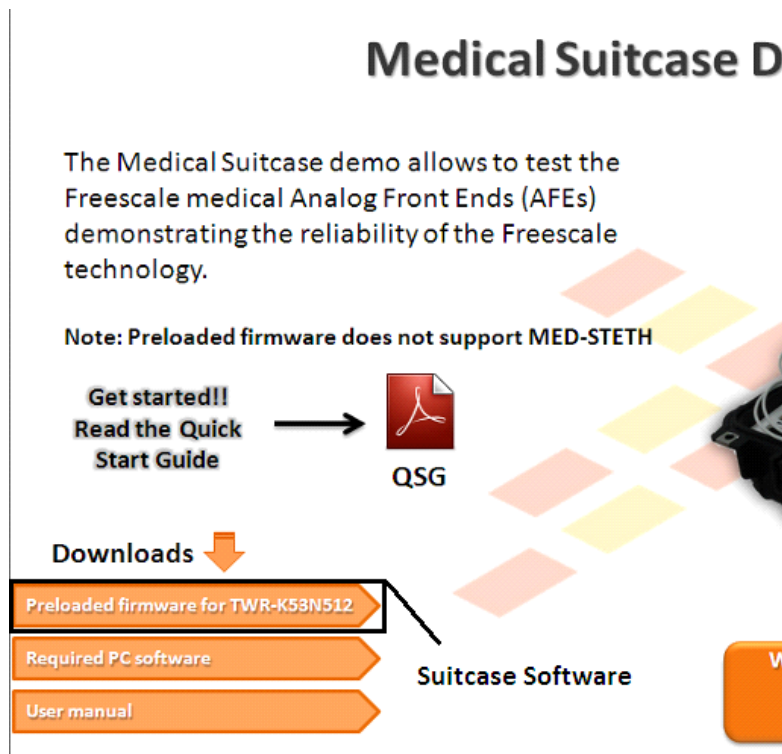


Figure 21. Loading Software (Step 3b)

4. Connect the TWR-MK53N512 module of the Tower system to the computer using a Mini USB-to-USB cable.

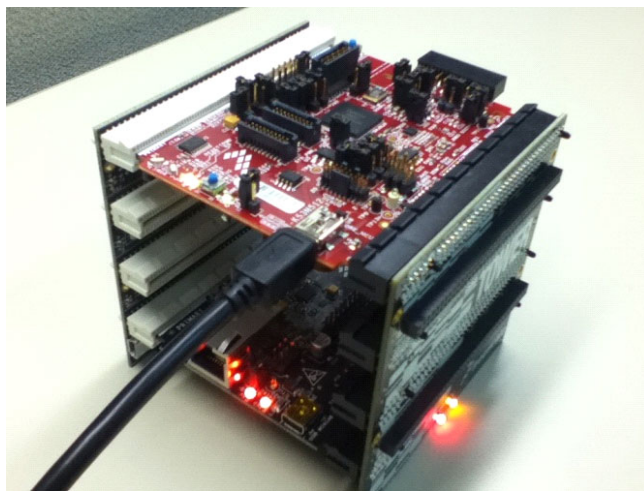


Figure 22. Loading Software (Step 4)

5. Make sure the debugger in the project options panel is PE micro. To ensure this, click Menu Project/Options.

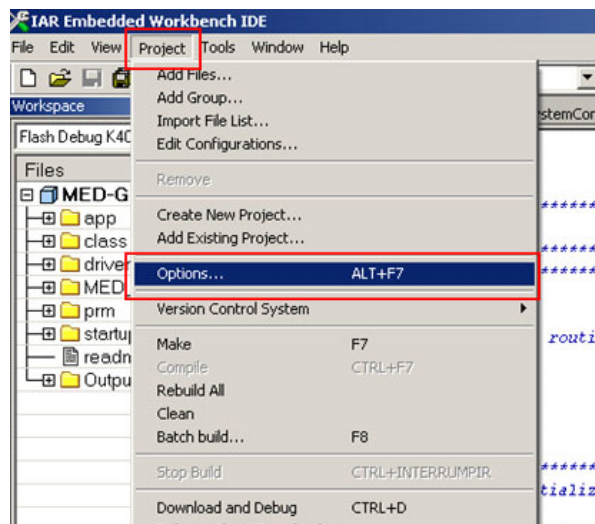


Figure 23. Loading Software (Step 5)

6. Select the category Debugger and ensure PE micro is selected.

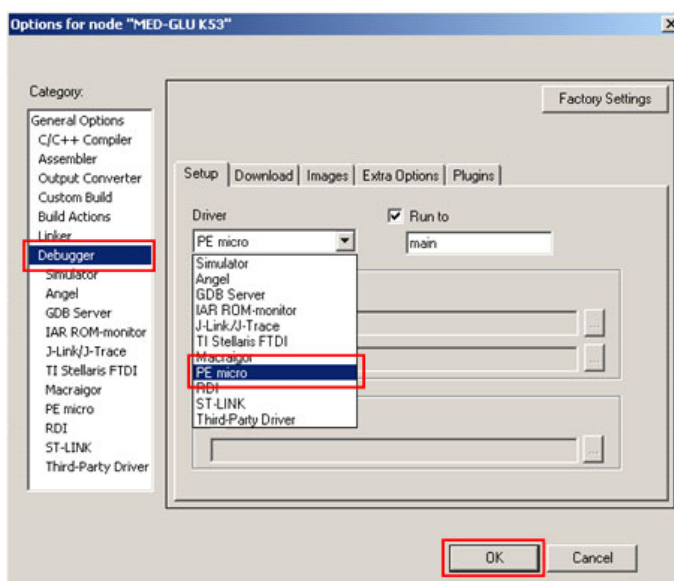


Figure 24. Loading Software (Step 6)

7. Click the debug button and the project will load into the MCU.

Loading Software

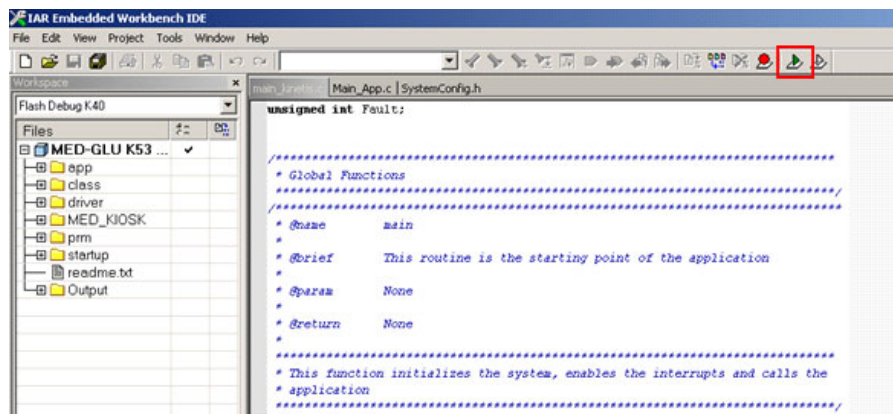


Figure 25. Loading Software (Step 7a)

The project will compile automatically and load into the MCU. The debugging session will then start.

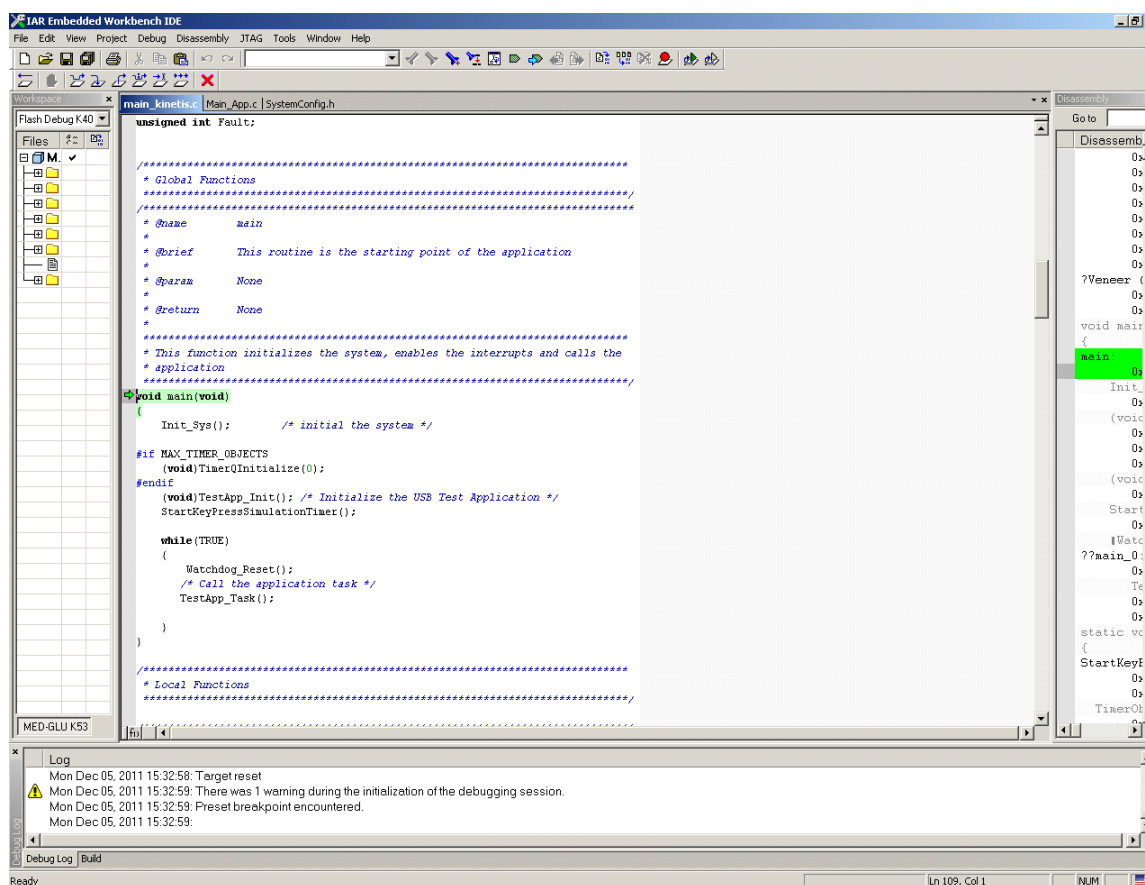


Figure 26. Loading Software (Step 7b)

8. Disconnect the USB cable from the TWR-K53N512 board and close "IAR Embedded Workbench IDE". A window with the message "This will terminate the debug session" will appear. Click "OK".

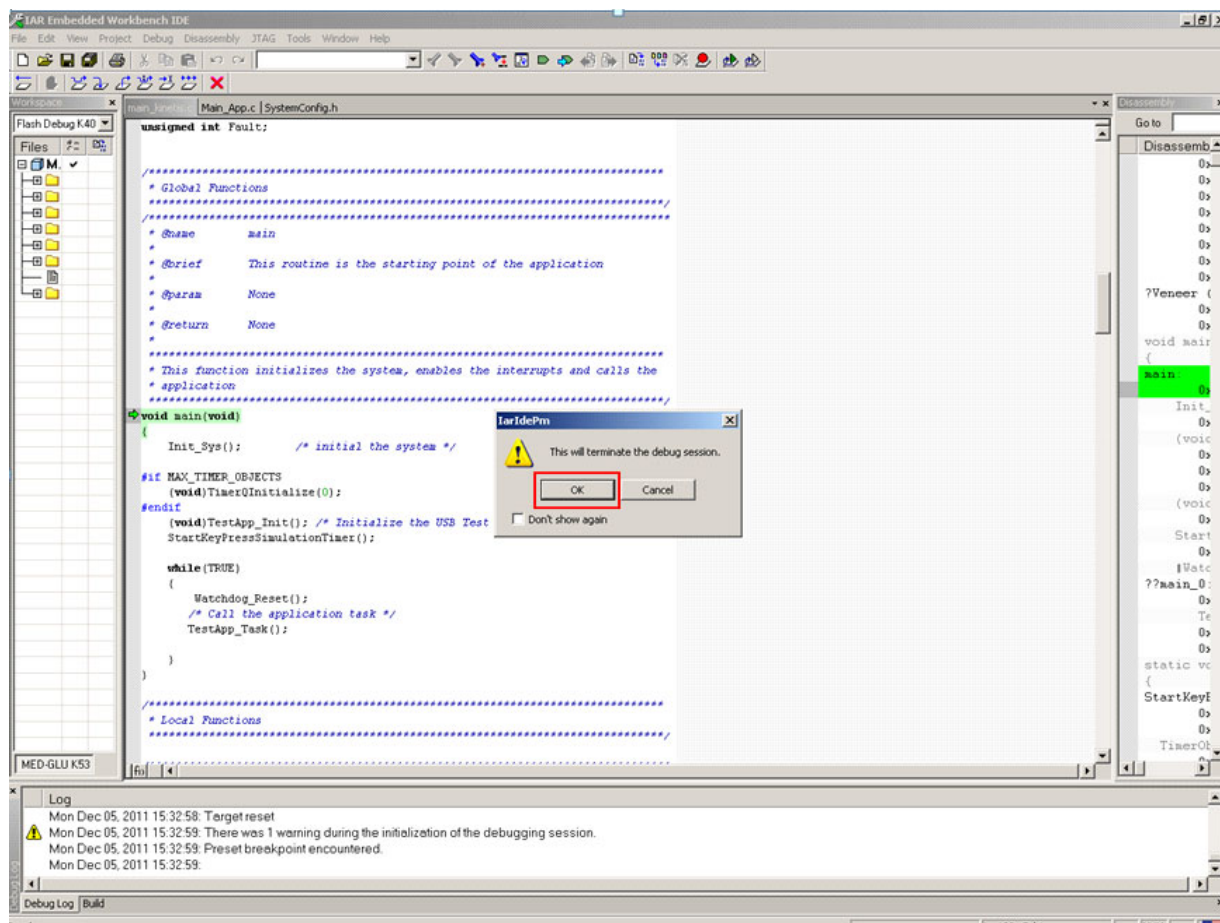


Figure 27. Loading Software (Step 8)

2.4 Installing the Graphical User Interface (GUI)

Follow these steps to install the Medical GUI.

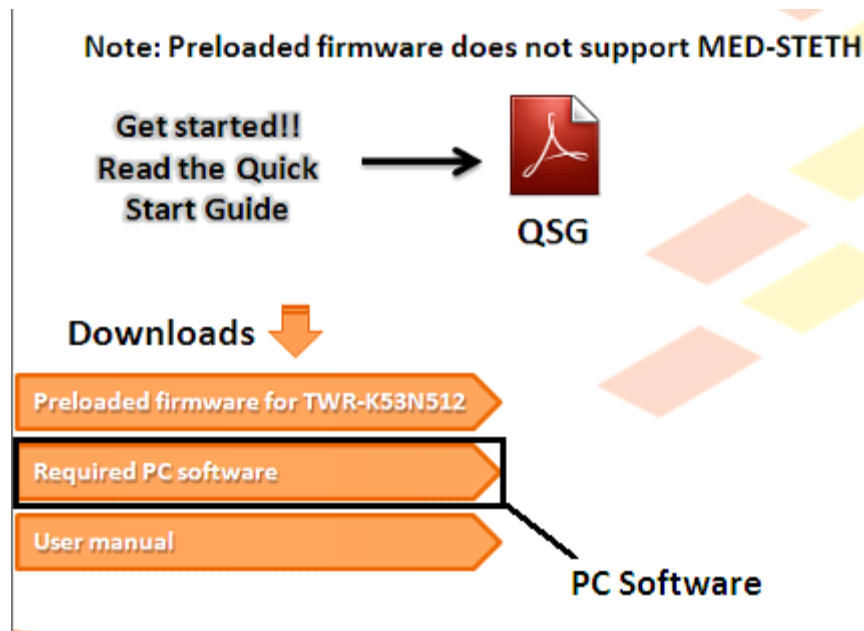


Figure 28. Installing Medical GUI

1. Download the Medical GUI from the Freescale website. The Medical GUI can be found when searching for "Medical GUI".

[K51_100 : Kinetis K51 Measurement 100 MHz MCUs \(plain\)](#) ☆
Kinetis K51 Measurement 100 MHz MCUs up to 512 KB Flash

[Medical GUI \(zip\)](#) ☆
Graphic user interface for use with software included in App Notes

[MEDBPMQSG : MED-BPM Blood Pressure Monitor Plug-In Board - Quick Start Guide \(pdf\)](#) ☆
MED-BPM is a development board that eases and accelerates the design of blood pressure monitoring applications. It is..

[Hospital Admission Machine \(html\)](#) ☆
In this application we use communication interfaces, user interfaces, memories, a great variaety of modules, modules...

Figure 29. Installing Medical GUI (Step 1)

2. Download and install the latest version of Java JDK on your computer. This can be downloaded from the Oracle® Web Page.

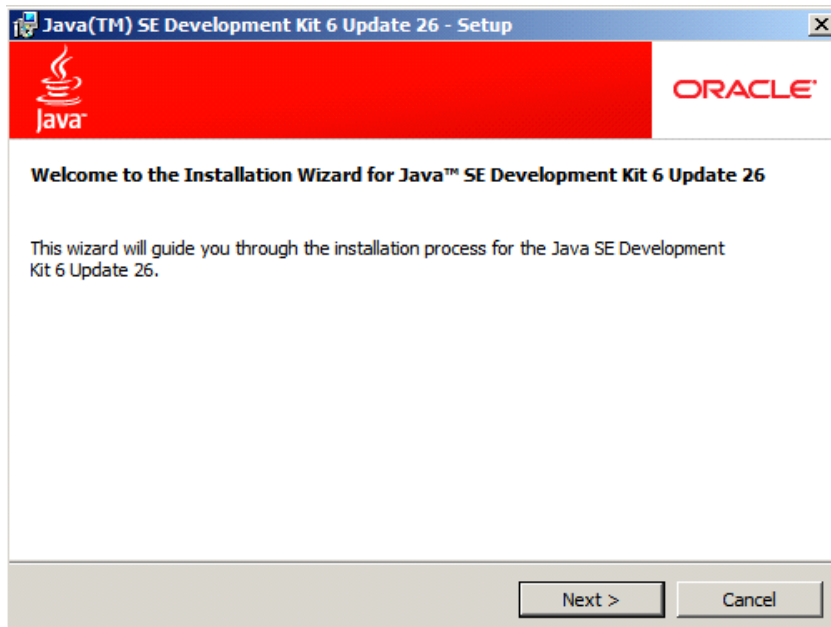


Figure 30. Installing Medical GUI (Step 2a)

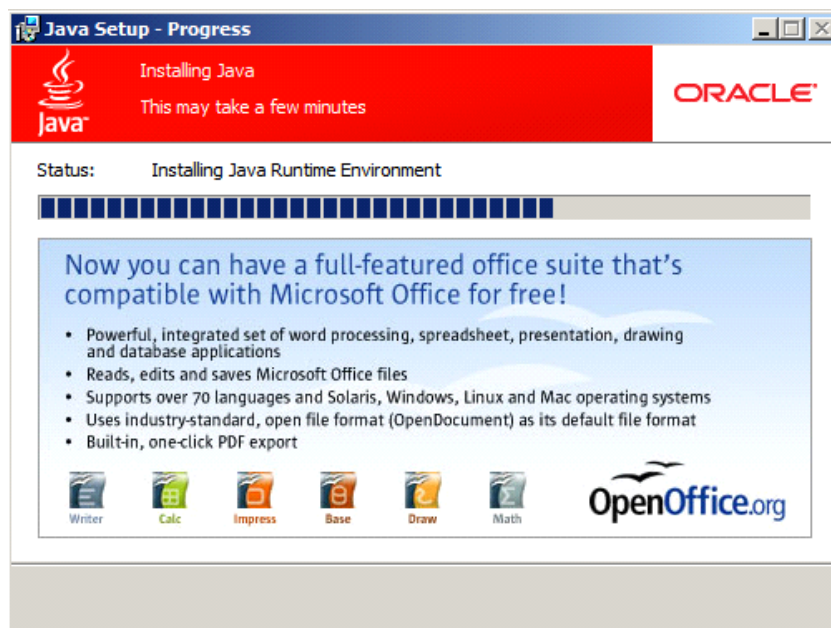


Figure 31. Installing Medical GUI (Step 2b)

3. Download and install the latest version of Java JMF on your computer that can be downloaded from Oracle® Web Page.

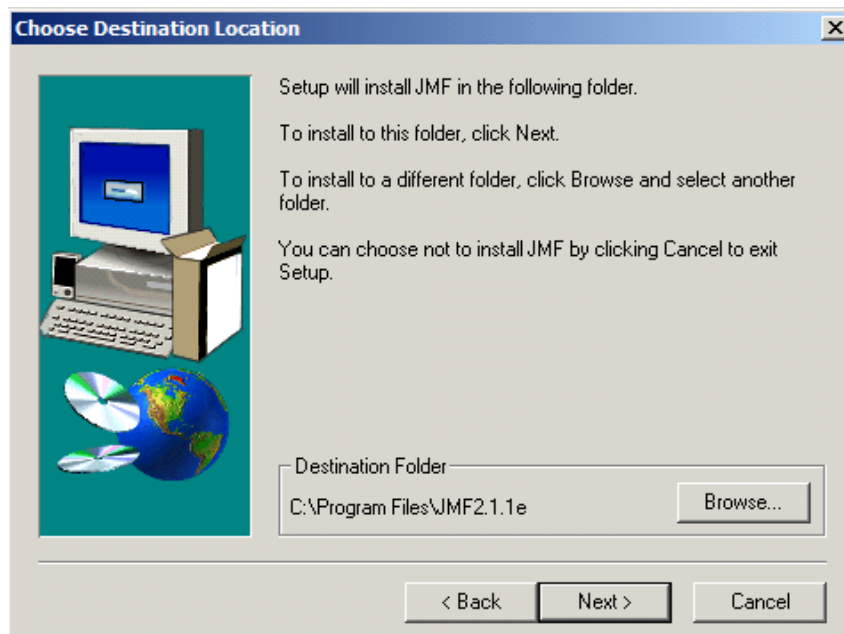


Figure 32. Installing Medical GUI (Step 3a)

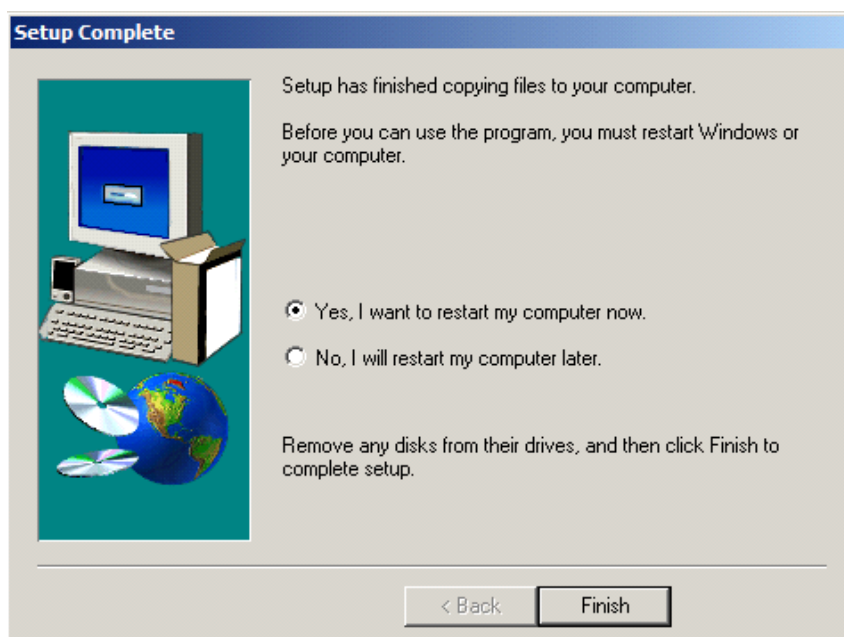


Figure 33. Installing Medical GUI (Step 3b)

4. Execute medical_gui_setup.exe.

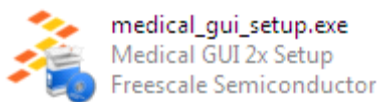


Figure 34. Installing Medical GUI (Step 4)

5. If a security warning like the following appears, click "Run".

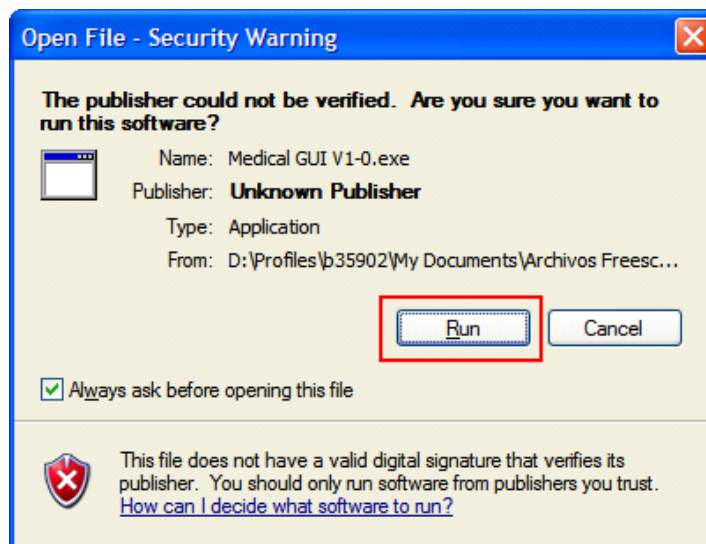


Figure 35. Installing Medical GUI (Step 5)

6. On the first screen of the installation process, click "Next".



Figure 36. Installing Medical GUI (Step 6)

7. If you have already installed Java JDK and Java JMF, ignore the Readme screen and click "Next". Otherwise, cancel the installation and refer to steps 2 and 3.

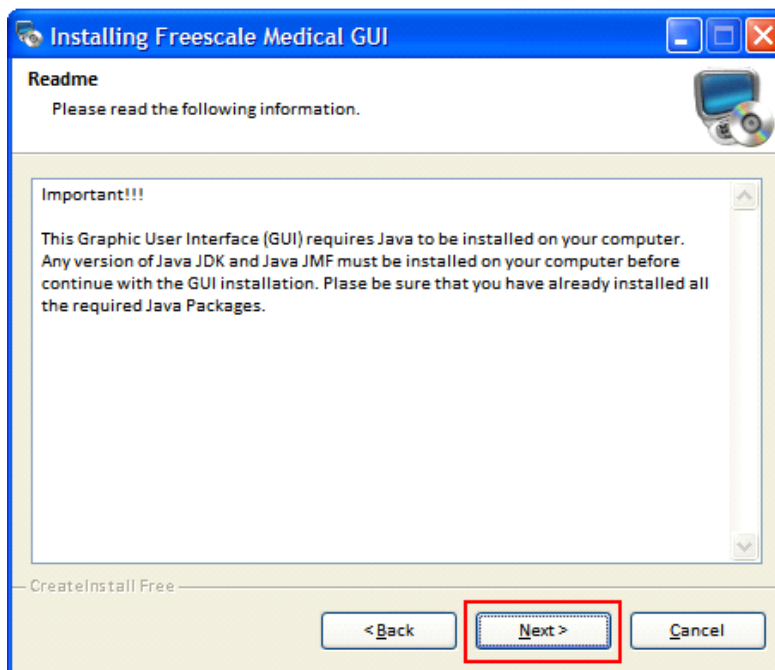


Figure 37. Installing Medical GUI (Step 7)

8. Take time to read the license agreement in the next screen. If you accept all the terms exposed, select "I agree with the above terms and conditions" and click "Next".

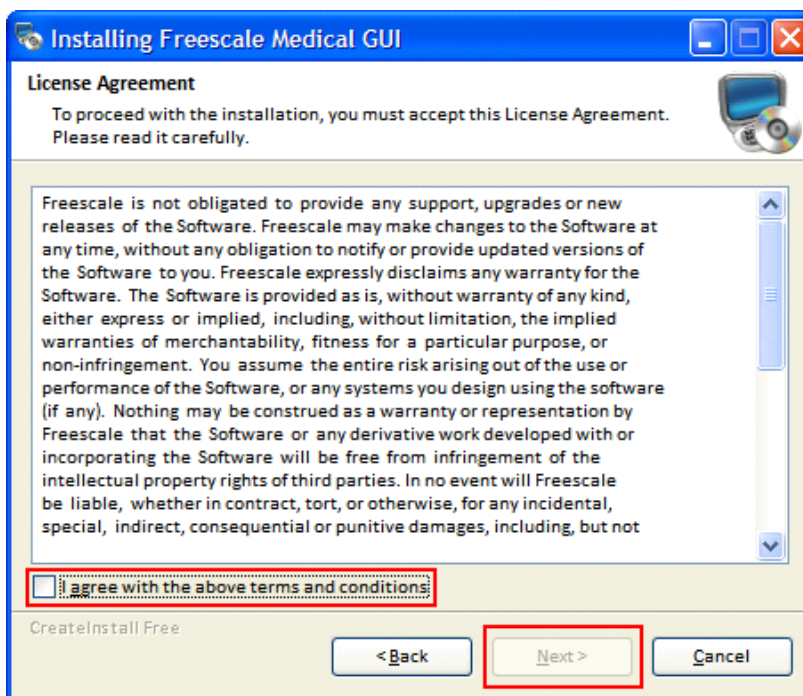


Figure 38. Installing Medical GUI (Step 8)

9. Select the desired destination folder, or leave the default path and click "Next".

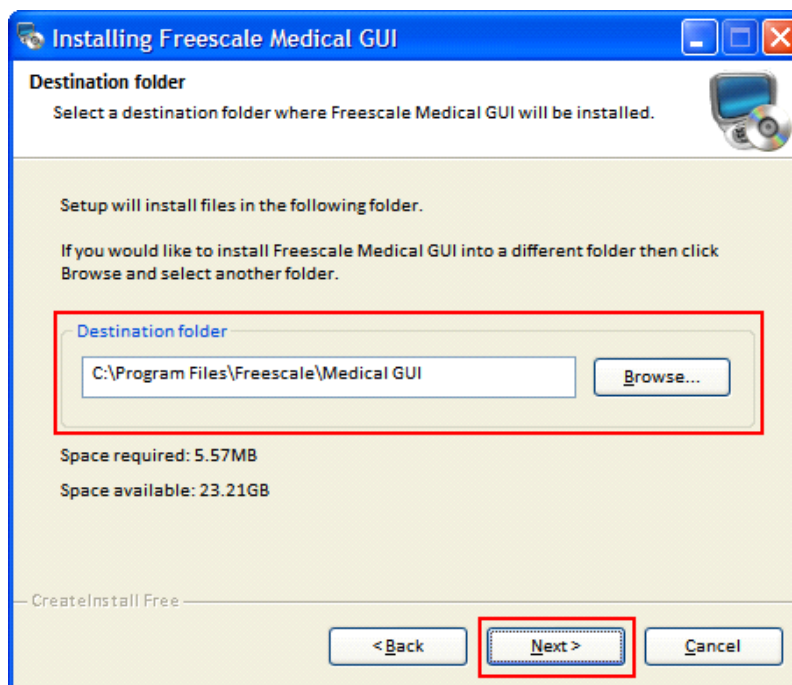


Figure 39. Installing Medical GUI (Step 9a)

The software will then be immediately installed to the computer.

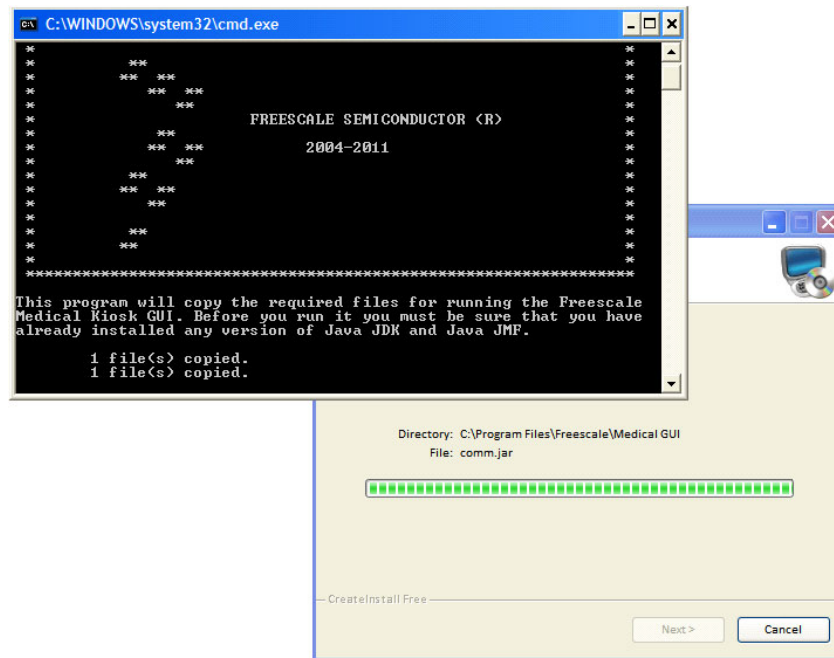


Figure 40. Installing Medical GUI (Step 9b)

10. After the installation is complete, click "Finish" on the last screen.



Figure 41. Installing Medical GUI (Step 10a)

A shortcut will appear on the Desktop and the menu programs.



Figure 42. Installing Medical GUI (Step 10b)

2.5 Installing the Virtual Com Port Driver

After the GUI has been installed and the software downloaded to the microcontroller, the Tower System Medical Demo is ready to be connected.

1. Connect the TWR-SER to the host computer as follows:

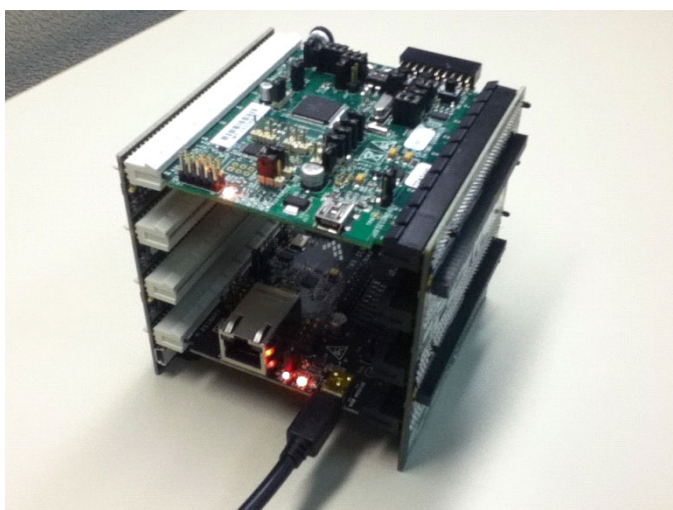


Figure 43. Connecting Virtual Com Port (Step 1)

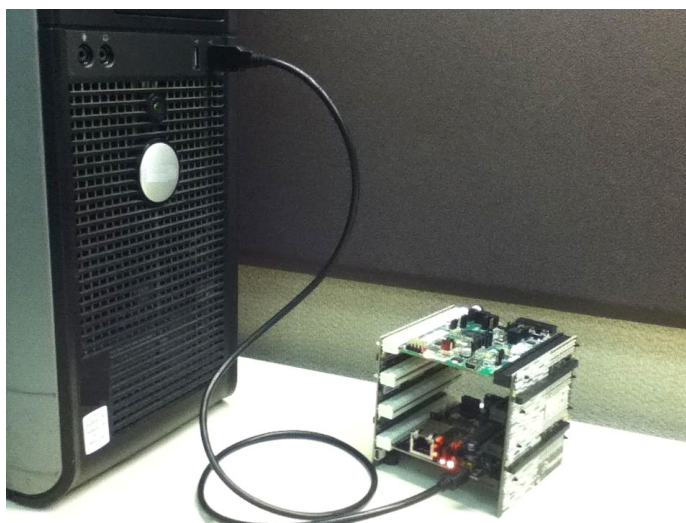


Figure 44. Connecting Virtual Com Port (Step 2)

Loading Software

The demo is recognized as a Virtual Com Port:



Figure 45. Connecting Virtual Com Port (Step 3)

Follow these steps to install the driver.

1. At the "Found New Hardware Wizard" screen, select "No, not this time" and click "Next".

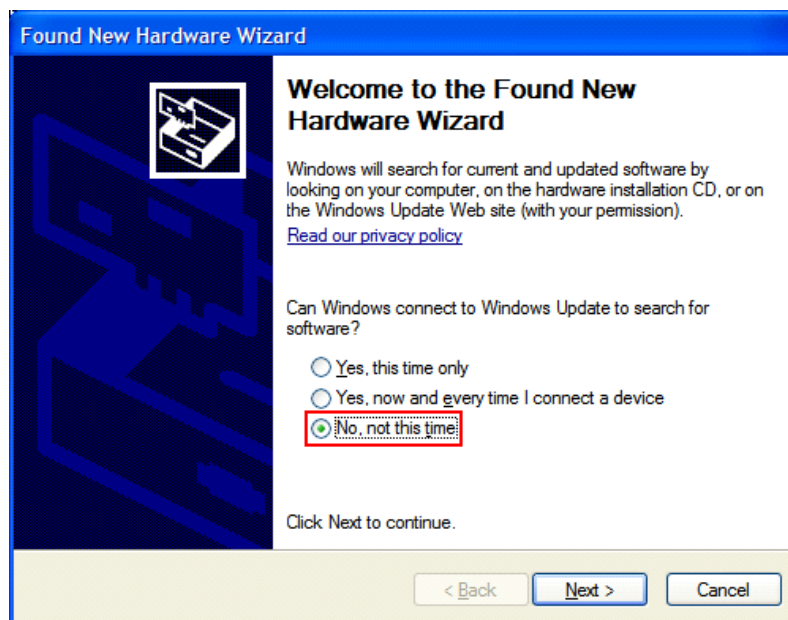


Figure 46. Installing Driver (Step 1)

2. When asked "What do you want the wizard to do?" click "Install from a list or specific location".

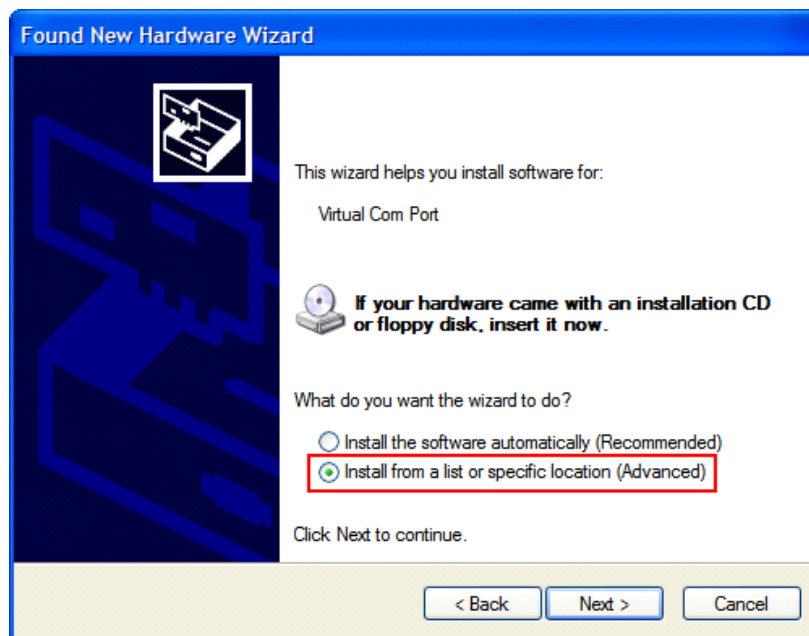


Figure 47. Installing Driver (Step 2)

3. In the next window, click "Browse" and select the following folder: C:\Freescale\Medical GUI\Drivers\x32 or x64 depending on your Windows OS.

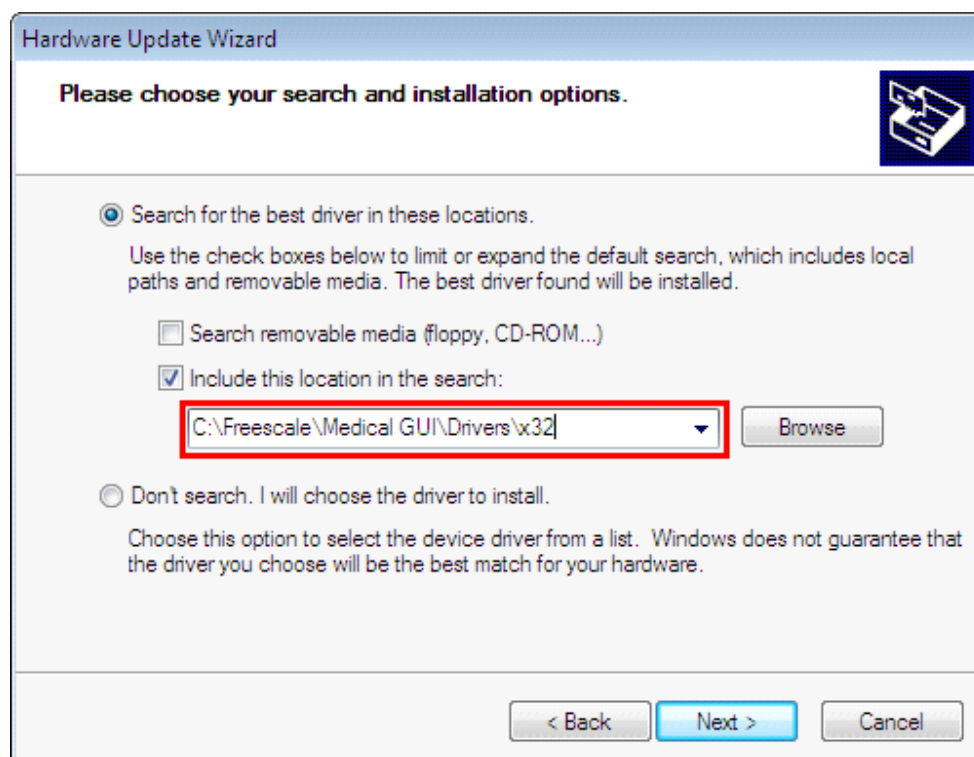


Figure 48. Installing Driver (Step 3)

Loading Software

4. If you see the following dialog box, click "Install this driver software anyway".

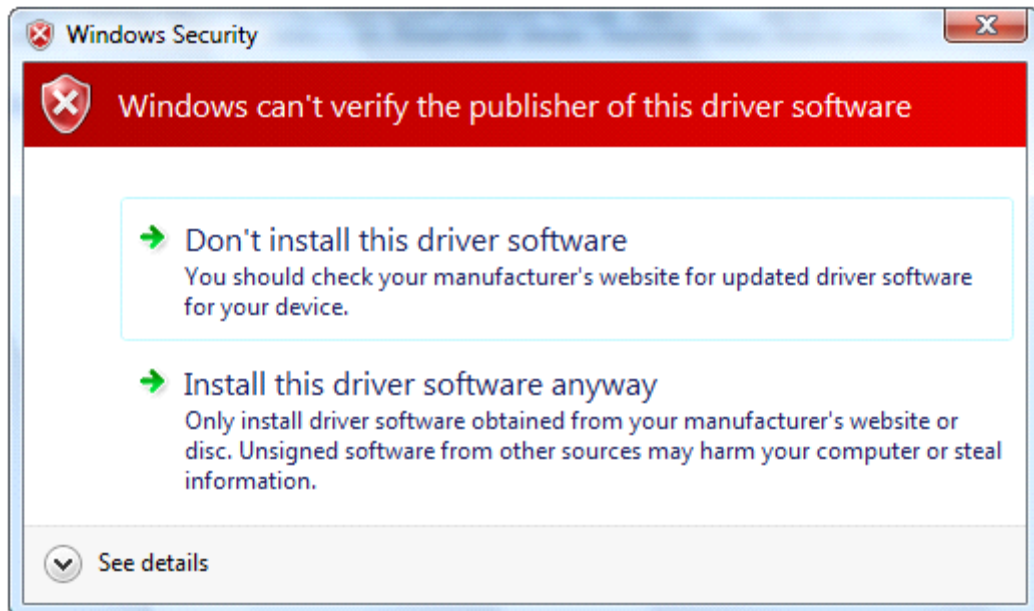


Figure 49. Installing Driver (Step 4a)

The computer will then install the proper driver:

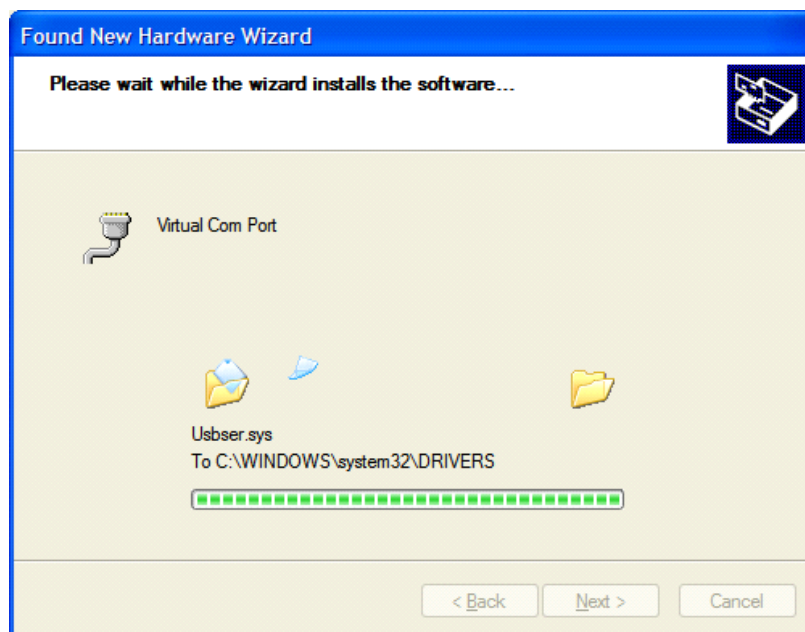


Figure 50. Installing Driver (Step 4b)

5. Click "Finish" to complete the installation. The following message should appear:

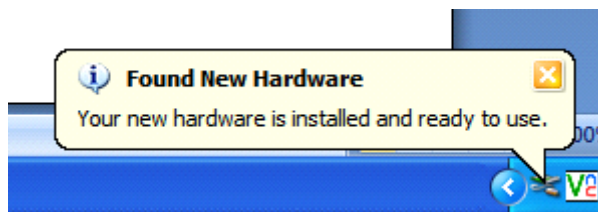


Figure 51. Installing Driver (Step 5)

3 Running Demo

All demos can run without reprogramming the controller board using the Healthcare AFE reference platform.

3.1 Assembling Demo

The first step to run this demo correctly is to connect the MED-SPI board to the TWR-K53N512 before the TWR-SER is connected to the computer.

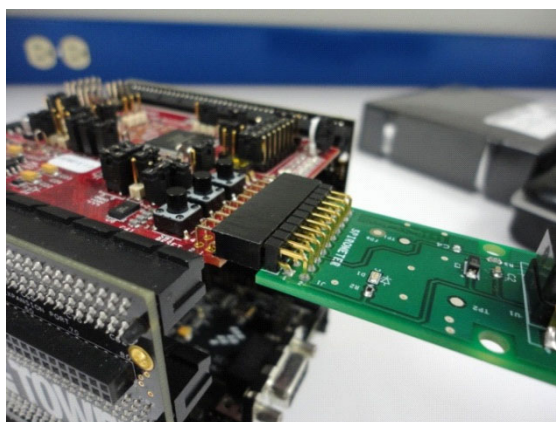


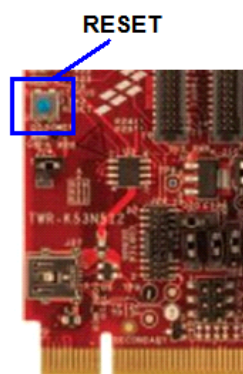
Figure 52. Assembling Demo

3.2 Opening the GUI

1. After the microcontroller has been programmed and the Medical Analog Front End board is connected to the TWR-K53N512, connect the TWR-SER to the computer using a Mini USB cable and press the reset button on the MCU board.



Figure 53. Opening GUI (Step 1a)



TWR-K53N512

Figure 54. Opening GUI (Step 1b)

2. Open Windows Device Manager and search for the port number assigned to the USB CDC Virtual Com, as this information will be requested by the GUI.

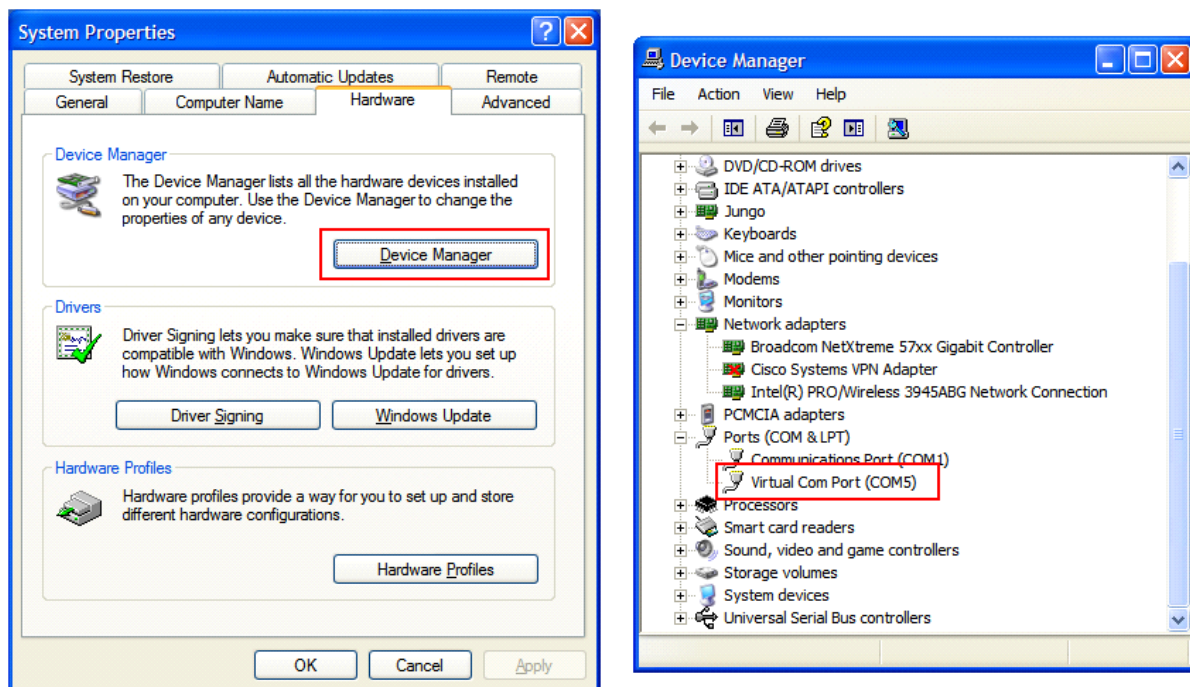


Figure 55. Opening GUI (Step 2)

3. Open the Medical GUI through the desktop icon or the programs menu. It will ask for a port number, obtained in the last step. Select the correct port and click on the OK icon.

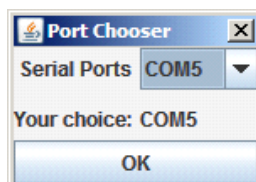


Figure 56. Opening GUI (Step 3)

4. The main screen of the GUI will appear.

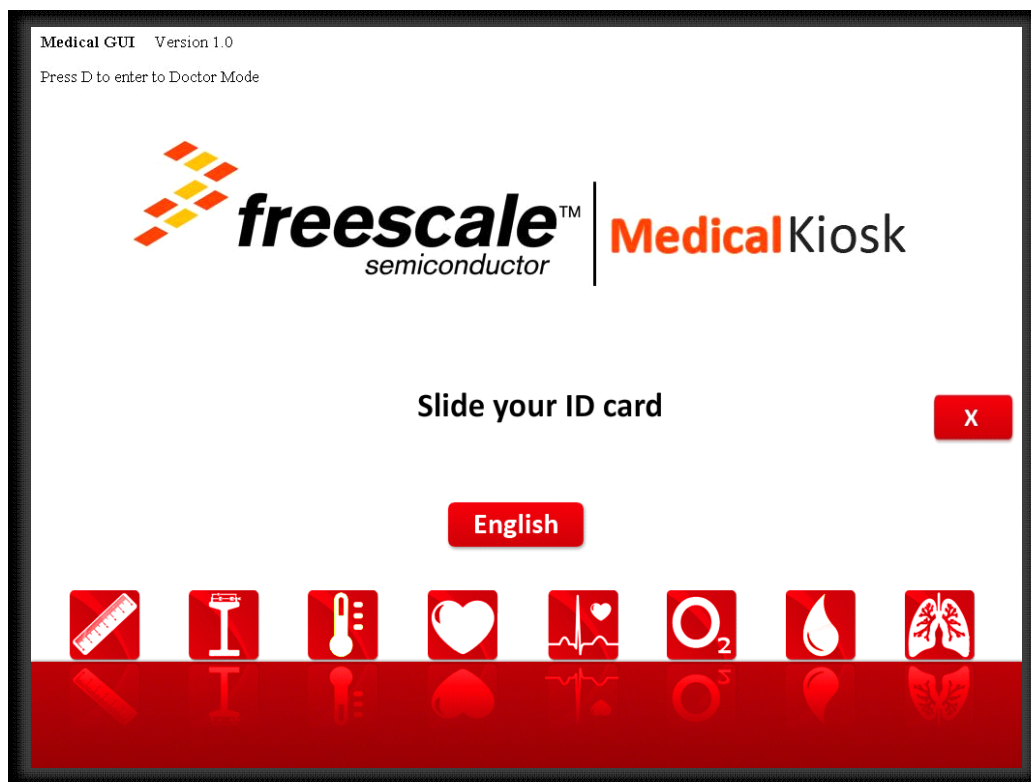


Figure 57. Opening GUI (Step 4)

3.3 Running tests

1. With the main screen of the GUI open, make sure that Caps Lock is not activated on your keyboard and press Shift + D to start the Doctor Mode.

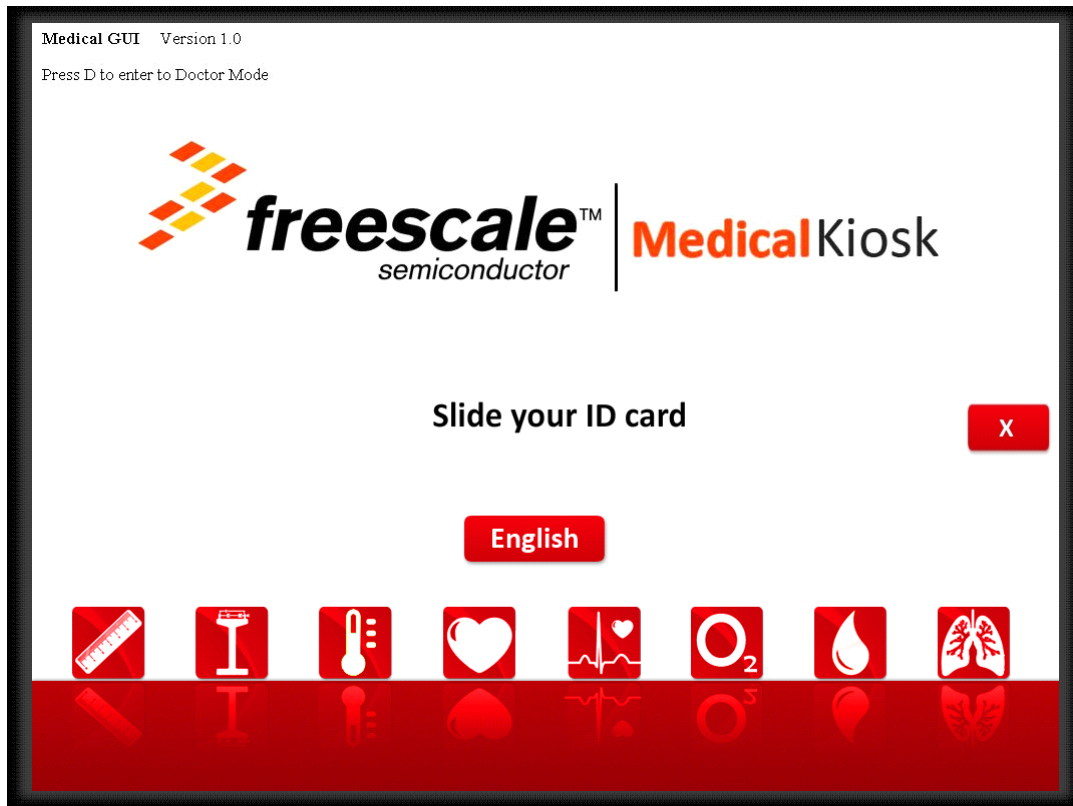


Figure 58. Running Tests (Step 1a)

Running Demo

With this software, we can run any of the MED-AFE demos in the Healthcare AFE reference platform

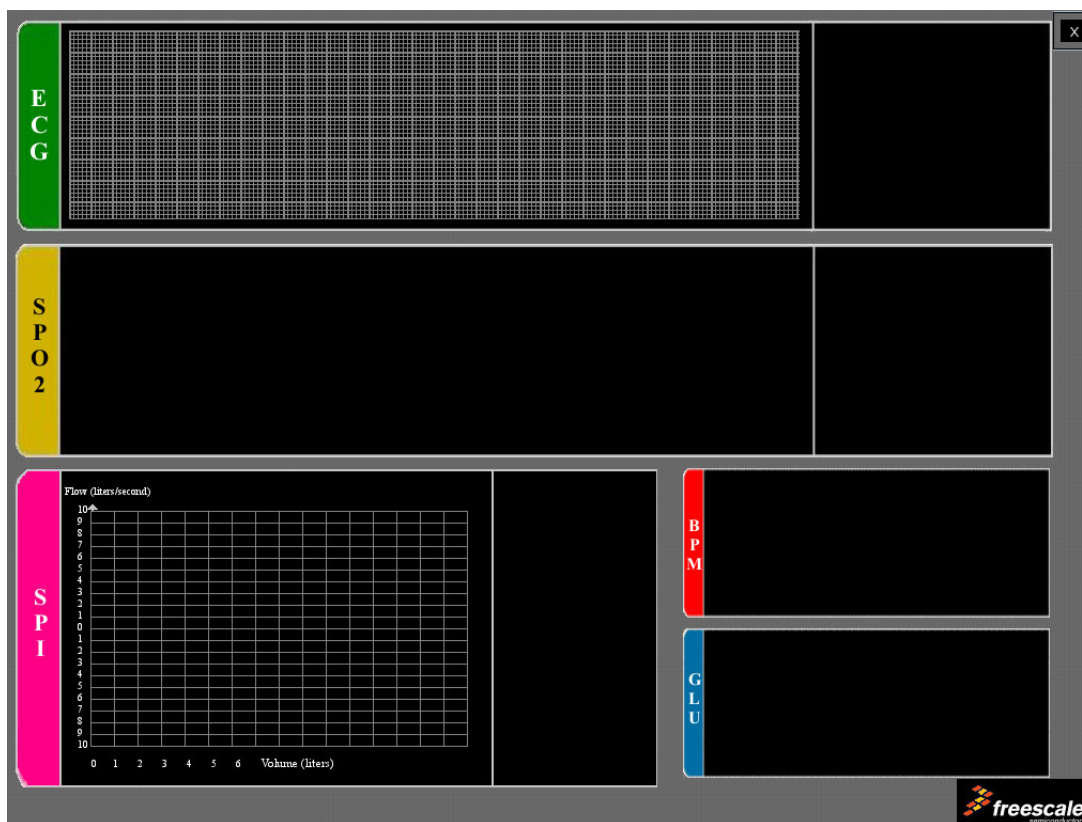


Figure 59. Running Tests (Step 1b)

(MED-BPM, MED-EKG, MED-SPO2, MED-GLU or MED-SPI) without reprogramming the controller board.

3.3.1 Running MED-SPO2

1. Connect the MED-SPO2 AFE.
2. Take the pulse oximeter sensor and connect it to the MED-SPO2 board. The DB9 male connector of the pulse oximeter sensor should be connected to the DB9 female connector on the MED-SPO2 board.

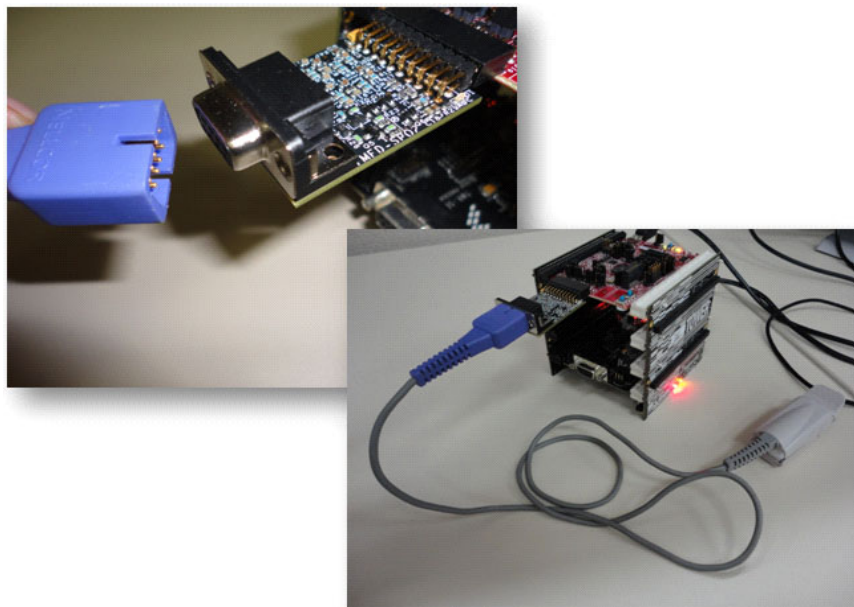


Figure 60. Running MED-SPO2 (Step 2)

3. Place your index finger on the pulse oximeter sensor, shown in the figure below.



Figure 61. Running MED-SPO2 (Step 3)

4. Go to the GUI and click the "SPO2" area. The pulse oximetry signal will appear on the grid and measurements will appear on the window over the grid. It will take at least 10 seconds for the signal to stabilize.

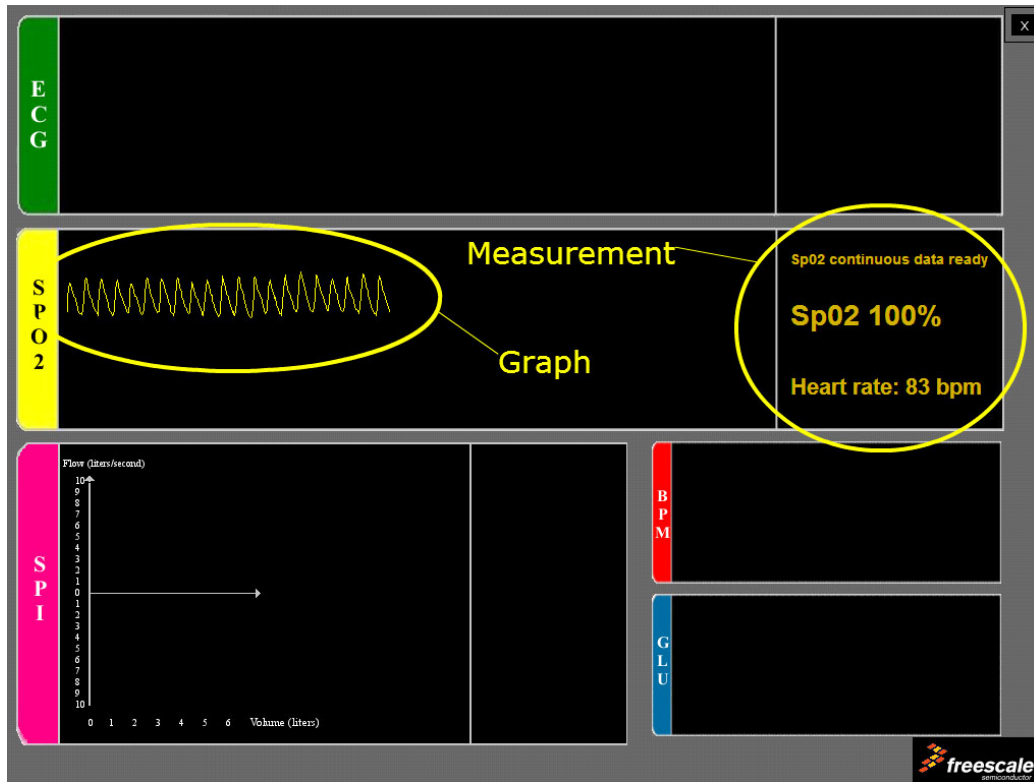


Figure 62. Running MED-SPO2 (Step 4)

5. Go to the GUI and click on the "SPO2" area again to stop the SPO2 measurements, then disconnect the MED-SPO2 board from the controller board.

3.3.2 Running MED-SPI

1. Connect the MED-SPI board.
2. Disinfect the probe before use.
3. Click the "SPI" area of the GUI. Slowly exhale and hold the spirometer tube in your hand.



Figure 63. Running MED-SPI (Step 3)

4. Place the tube in your mouth while making sure air does not leak out of the tube. Inhale as much as possible, using your so that your lungs are completely full. Then, without taking your mouth out of the tube, exhale so your abdominal muscles help release all air.



Figure 64. Running MED-SPI (Step 4)

5. Click the "SPI" area of the GUI. The screen will then show the parameters obtained as well as the spirometry graph.

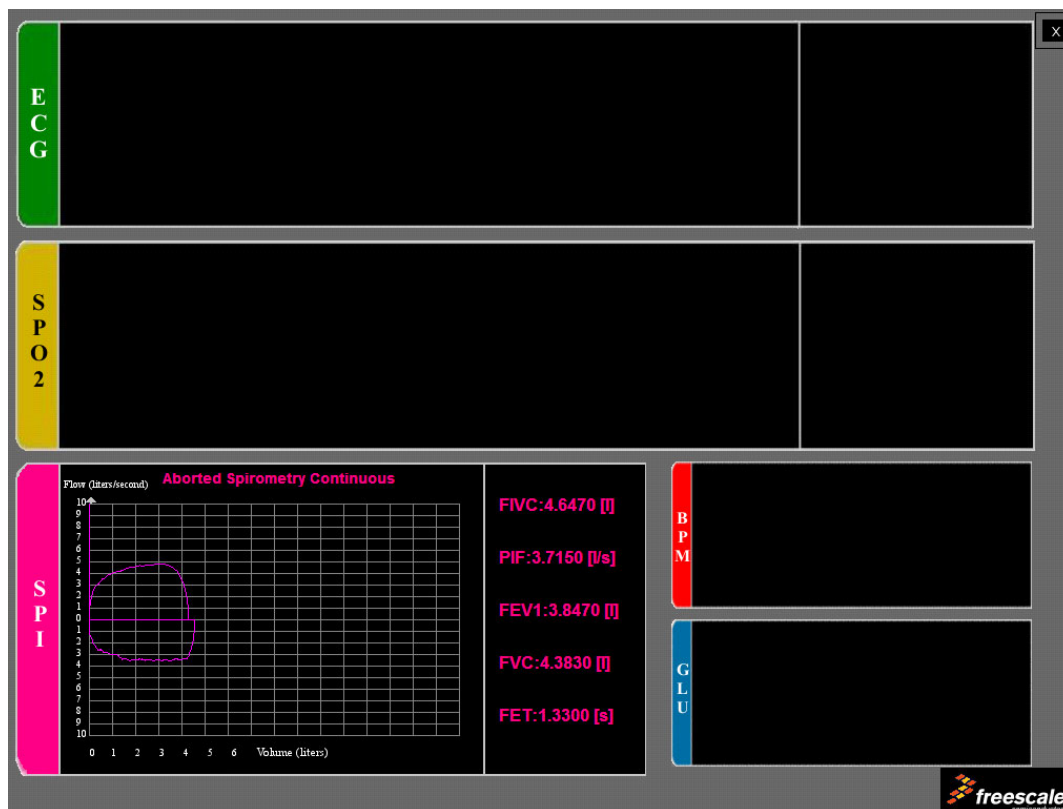


Figure 65. Running MED-SPI (Step 5)

6. The MED-SPI board can now be disconnected.

3.3.3 Running MED-EKG

1. Connect the MED-EKG board.
2. Connect the cables with the electrodes to the MED-EKG board.

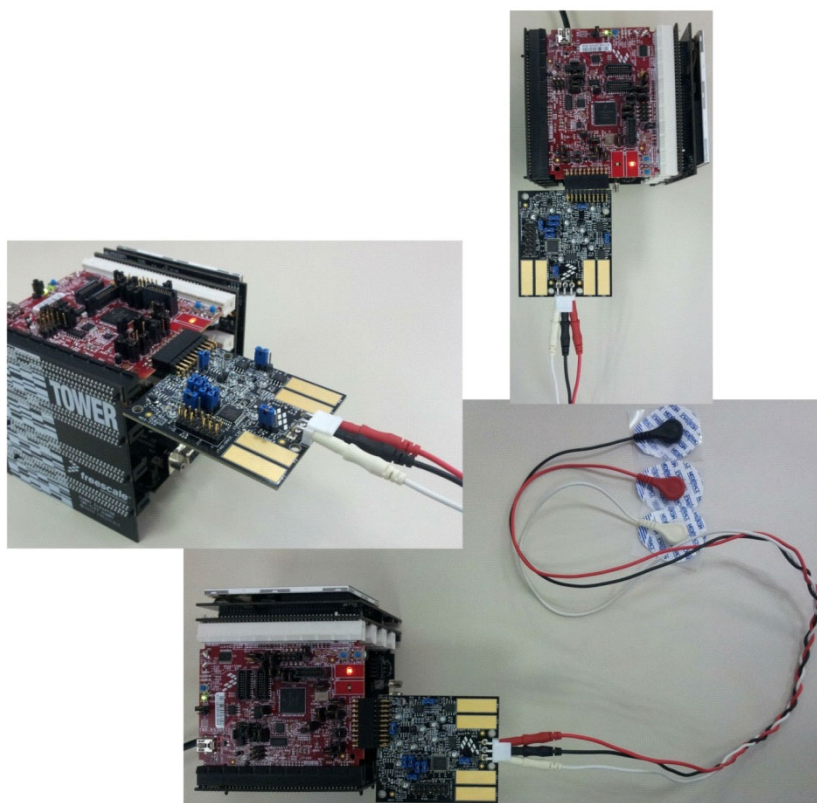


Figure 66. Running MED-EKG (Step 2)

3. If you want to run the test with the electrodes integrated in the MED-EKG board, ignore step 4 and proceed to step 6.
4. There are two options in how you are able to connect the electrodes to your body:
 - a. Attach the electrode with the white wire to your left arm.Attach the electrode with the red wire to your right arm.
Attach the electrode with the black wire near your left abdomen.

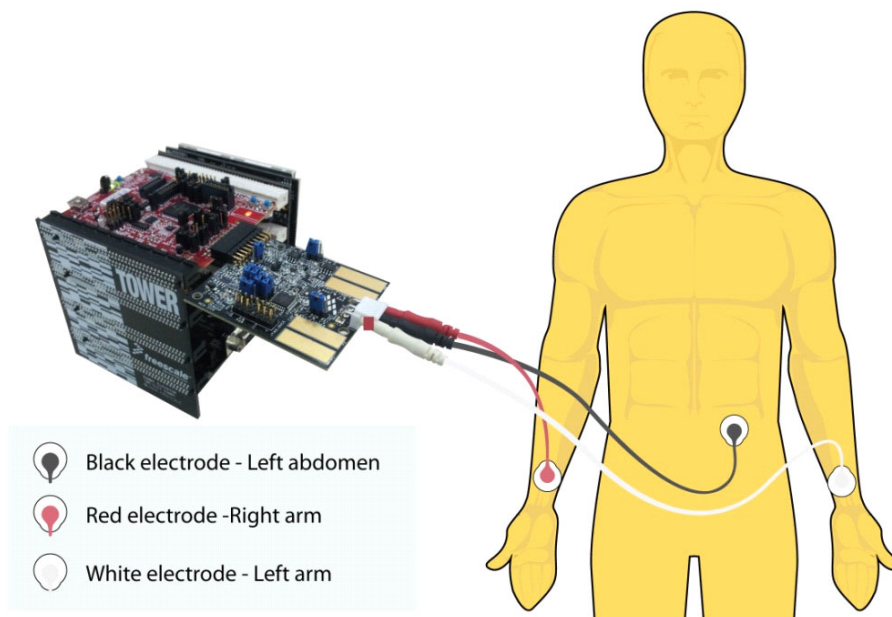


Figure 67. Running MED-EKG (Step 4a)

b. Attach the electrode with the white wire to your left upper chest.

Attach the electrode with the red wire to your right upper chest.

Attach the electrode with the black wire near your left abdomen.

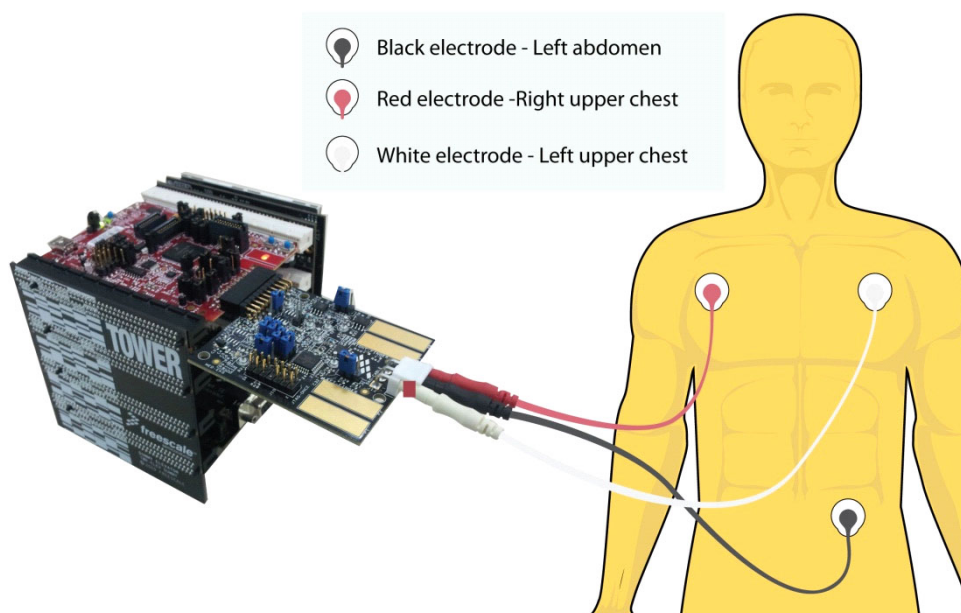


Figure 68. Running MED-EKG (Step 4b)

The process should resemble the following image:



Figure 69. Running MED-EKG (Step 4c)



Figure 70. Running MED-EKG (Step 4d)

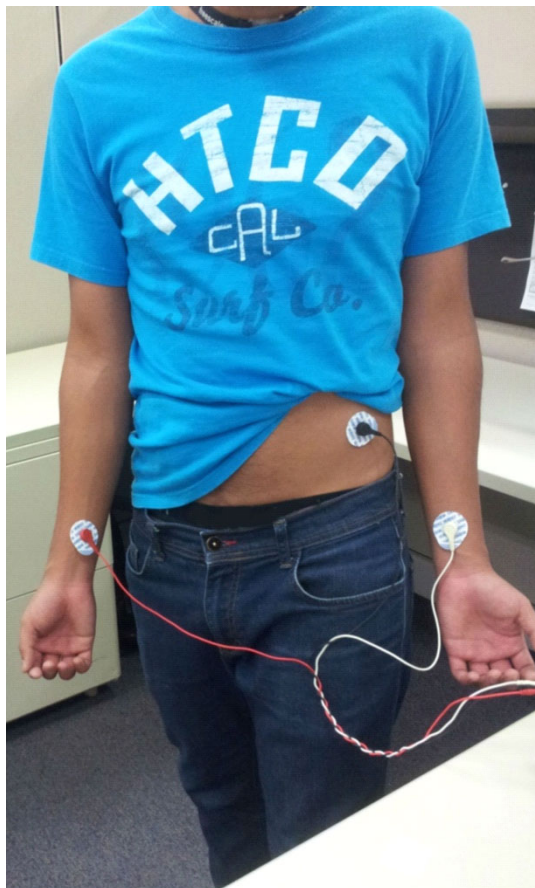


Figure 71. Running MED-EKG (Step 4e)

5. Go to the GUI and click the "ECG" area.

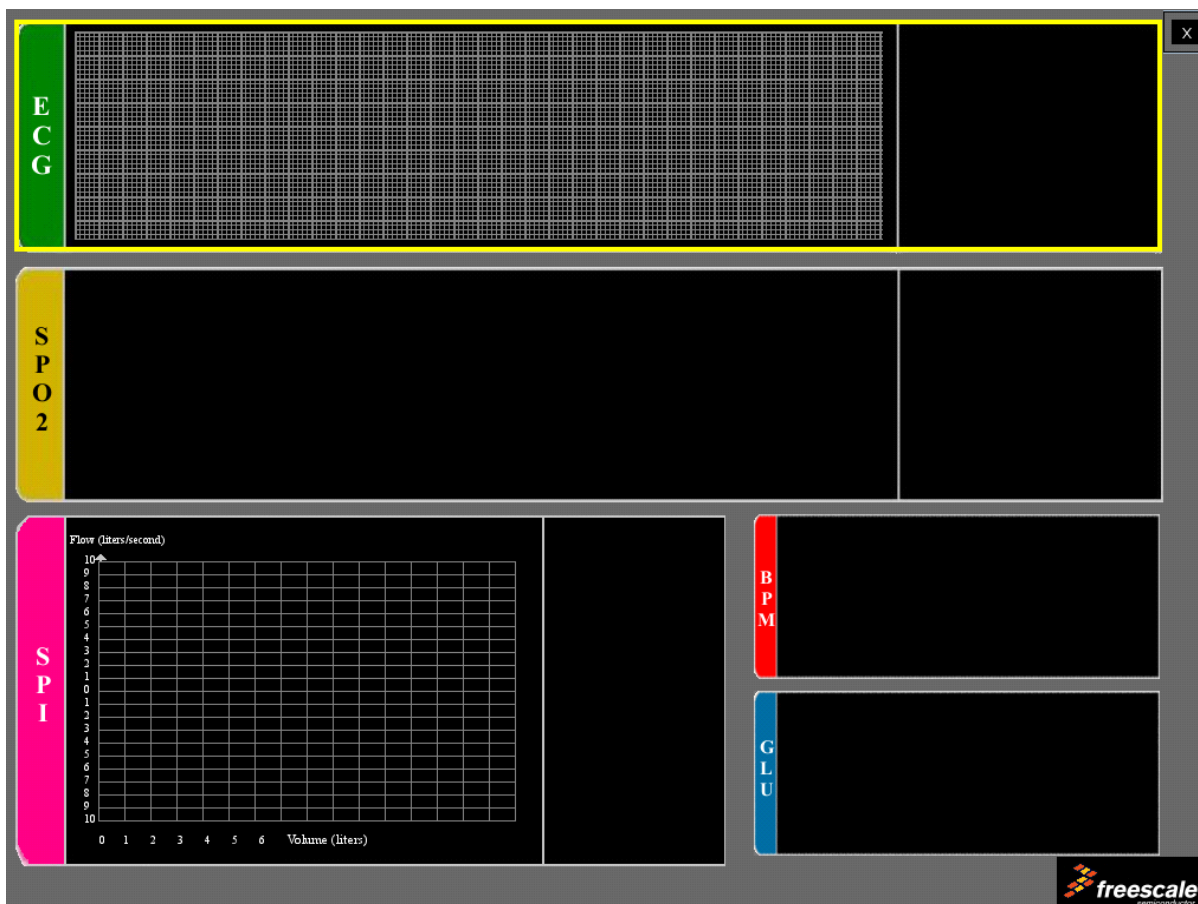


Figure 72. Running MED-EKG (Step 5)

6. If you are using the electrodes embedded in the MED-EKG board, remove any metallic rings and bracelets from your hands. Place the fingertip of your middle and index fingers of each hand and touch the corresponding electrodes on the board while holding the bottom part of the board with your thumbs, as shown in the following picture.

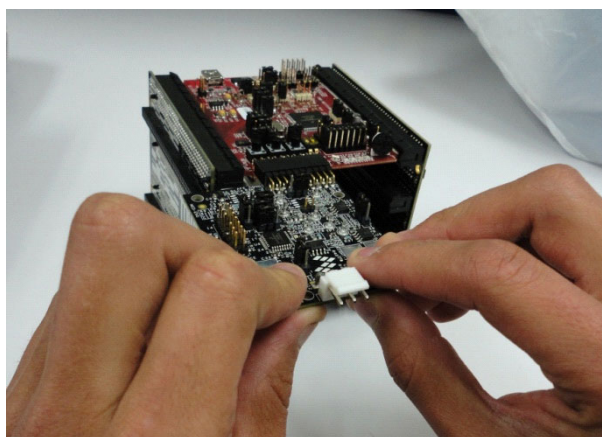


Figure 73. Running MED-EKG (Step 6)

Running Demo

7. Wait for signal stabilization for approximately 10 seconds. Avoid movement and relax as you breathe. The GUI will show the ECG signal and heart rate.

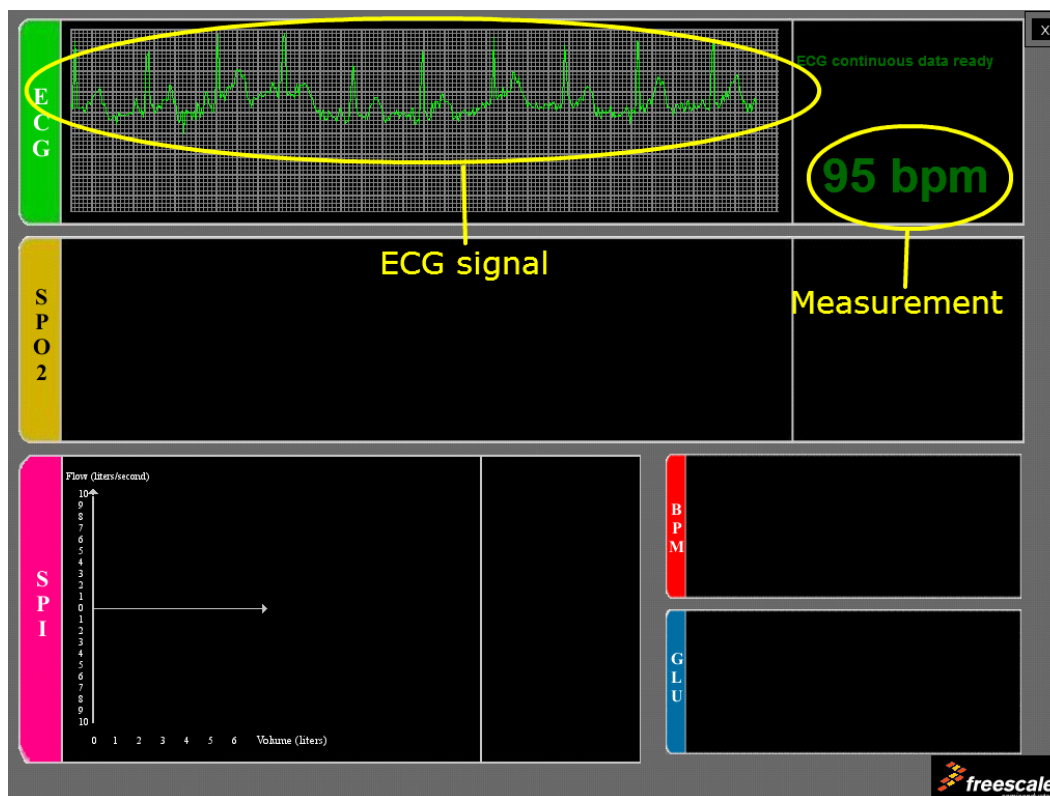


Figure 74. Running MED-EKG (Step 7)

8. Go to the GUI and click the "ECG" area again. This should stop the ECG measurements. Then, disconnect the MED-EKG board from the controller board.

3.3.4 Running MED-GLU

1. Connect the MED-GLU board.
2. Place the test strip at the AFE connector, making certain that the strip connectors are facing right side up.

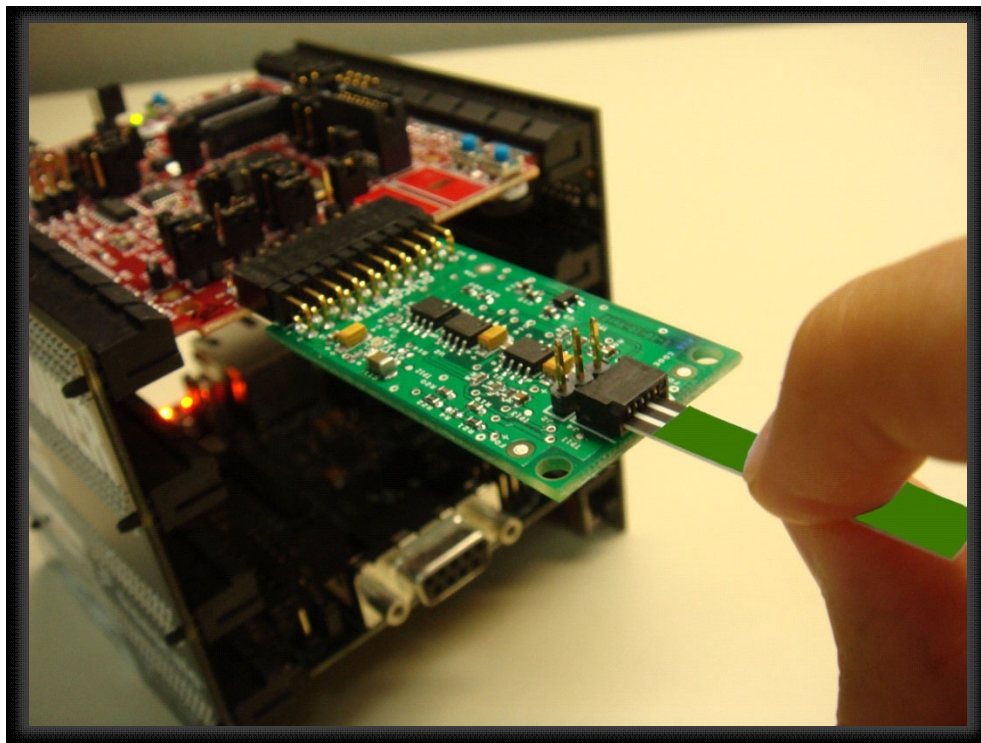


Figure 75. Running MED-GLU (Step 2)

3. Click the “GLU” area on the GUI.

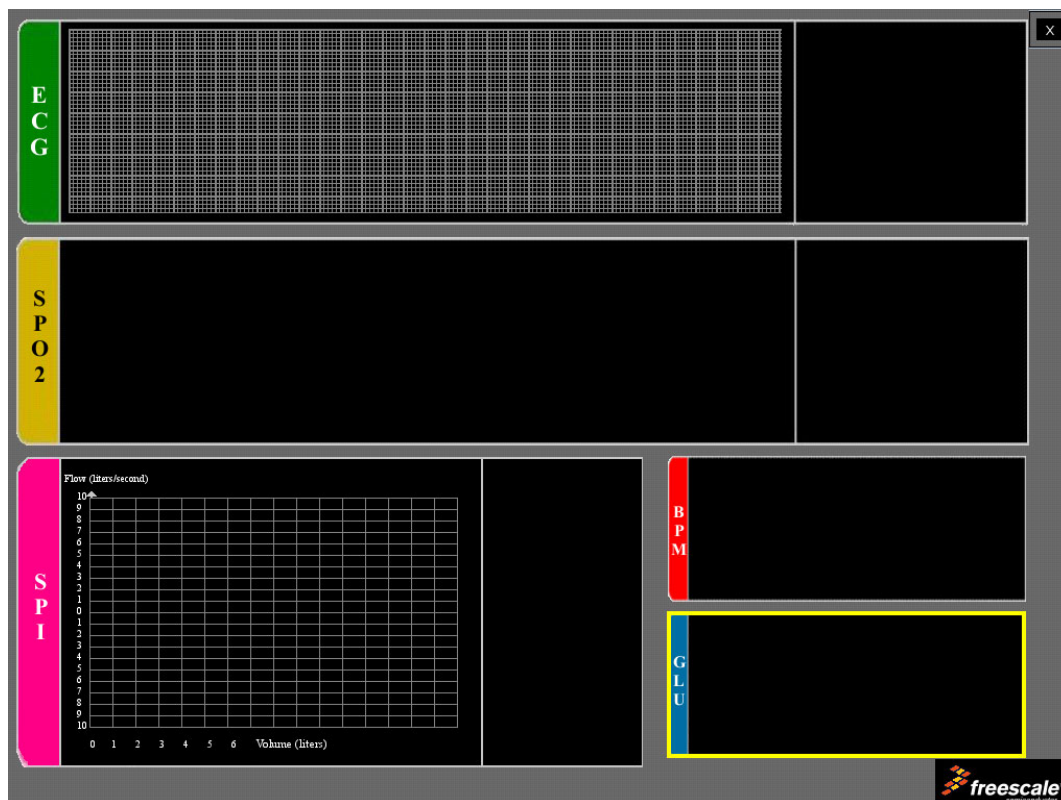


Figure 76. Running MED-GLU (Step 3)

4. Now place the glucose sample on the white target area at the end of the test strip. Be sure that the drop of solution is inserted on the edge of the strip and absorbed completely, otherwise the test will not be successful. You can use a syringe to place of the drop.

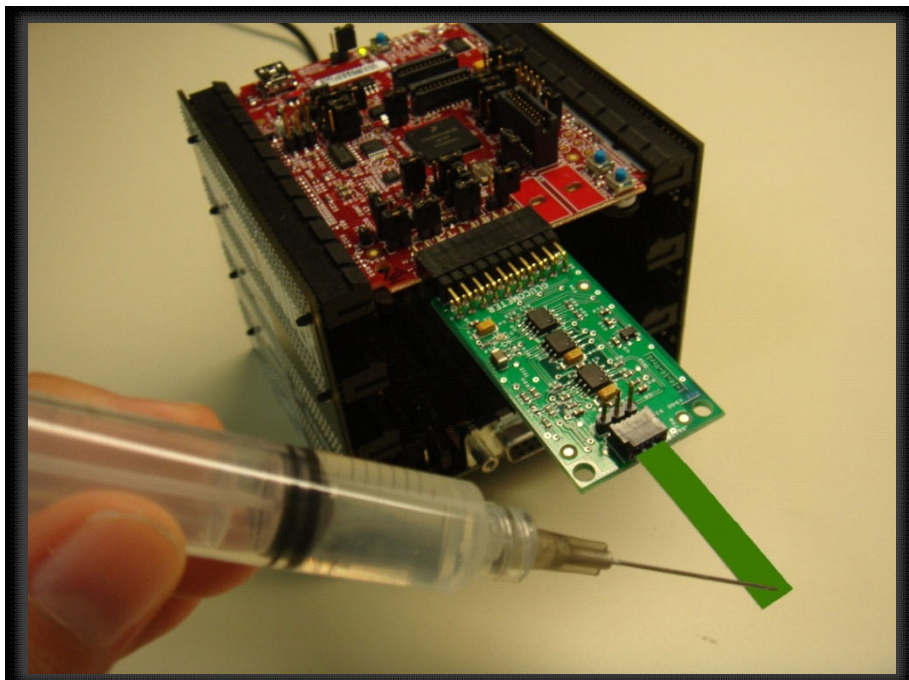


Figure 77. Running MED-GLU (Step 4)

5. When the drop of solution is absorbed, measurements will start. After 5 seconds, the measurements will appear onscreen.

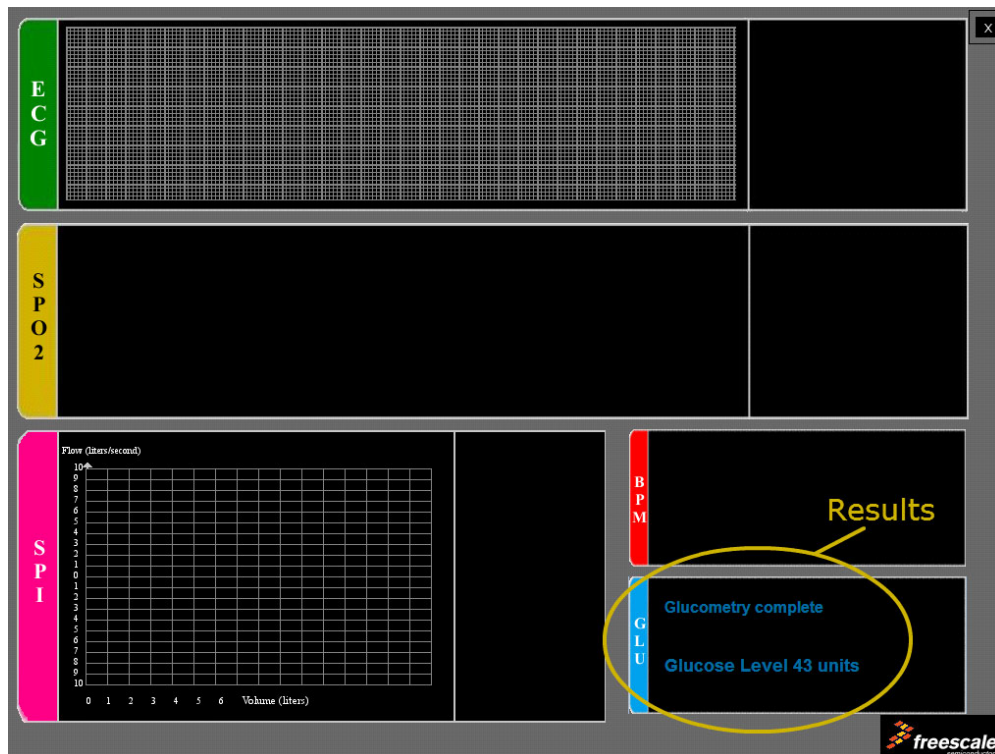


Figure 78. Running MED-GLU (Step 5)

6. After the result is shown, the test is finished. You do not need to press the "GLU" area again to abort the measurement and start another one with another AFE. Instead, simply disconnect the MED-GLU board from the controller board.

3.3.5 Running MED-BPM

1. Connect the MED-BPM board.
2. Make sure the blue box has two AA batteries connected. These are used for driving the escape valve and pump motor because the USB port cannot provide a sufficient current for those devices.
3. Remove any clothing on your upper left arm and wrap the cuff firmly around your left arm, about one inch above the elbow. make sure the hose is aligned to the innermost right side of your arm.



Figure 79. Running MED-BPM (Step 3)

4. Click the "BPM" area on the GUI for measurements to begin. Be seated and remain still while the cuff inflates and deflates. Do not speak or move during this time. The measurements will then appear onscreen.



Figure 80. Running MED-BPM (Step 4)

To change demos, the current measurement must be stopped or completed. The method of stopping will depend on the demo. For MED-SPO2 to stop, you must click the "SPO2" area. For MED-BPM, the measurement must be completed. For MED-EKG to stop, you must click the "ECG" area. For MED-GLU, the measurement must be completed. For MED-SPI, the normal procedure after completing the test is to click the "SPI" area to view the results and end the measurement.

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